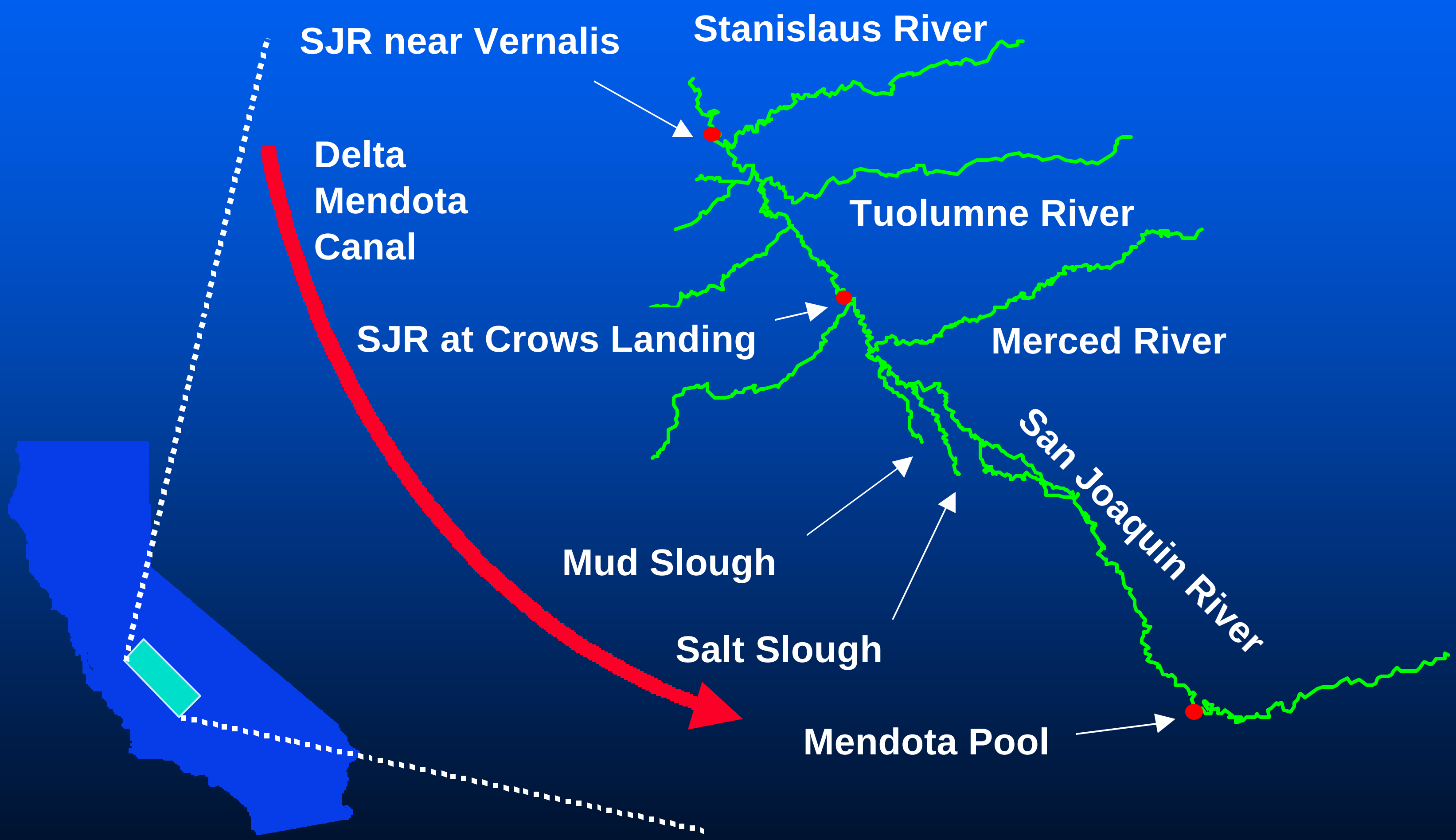
San Joaquin River
Basin Plan Amendment Addressing
Salinity and Boron

Background on San Joaquin River Water Quality

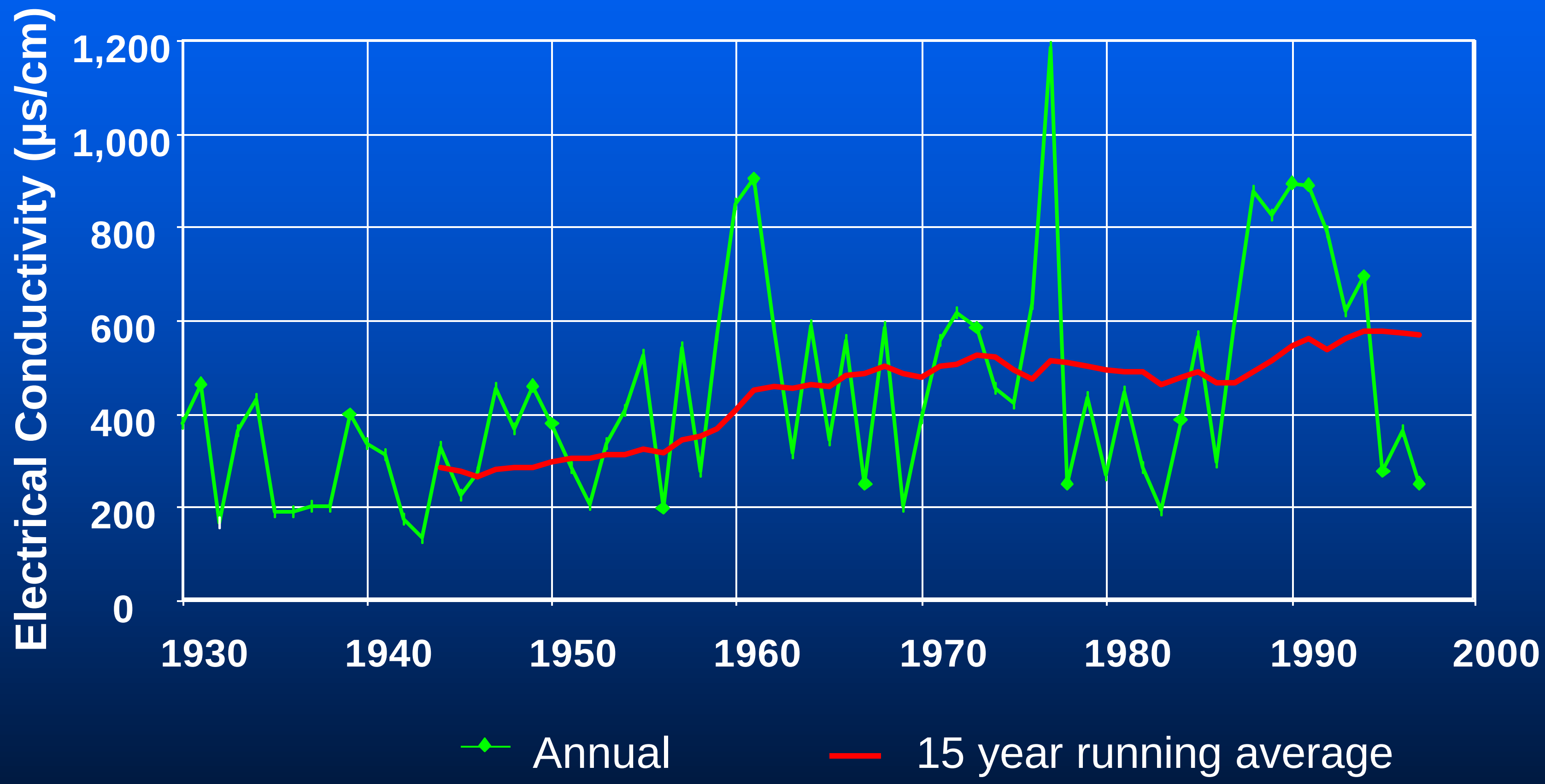
Technical Background

- Area of Concern
- Current Water Quality Objectives
- Past and Current Water Quality Conditions
- Changing Conditions
- Questions, Discussion, and Comments

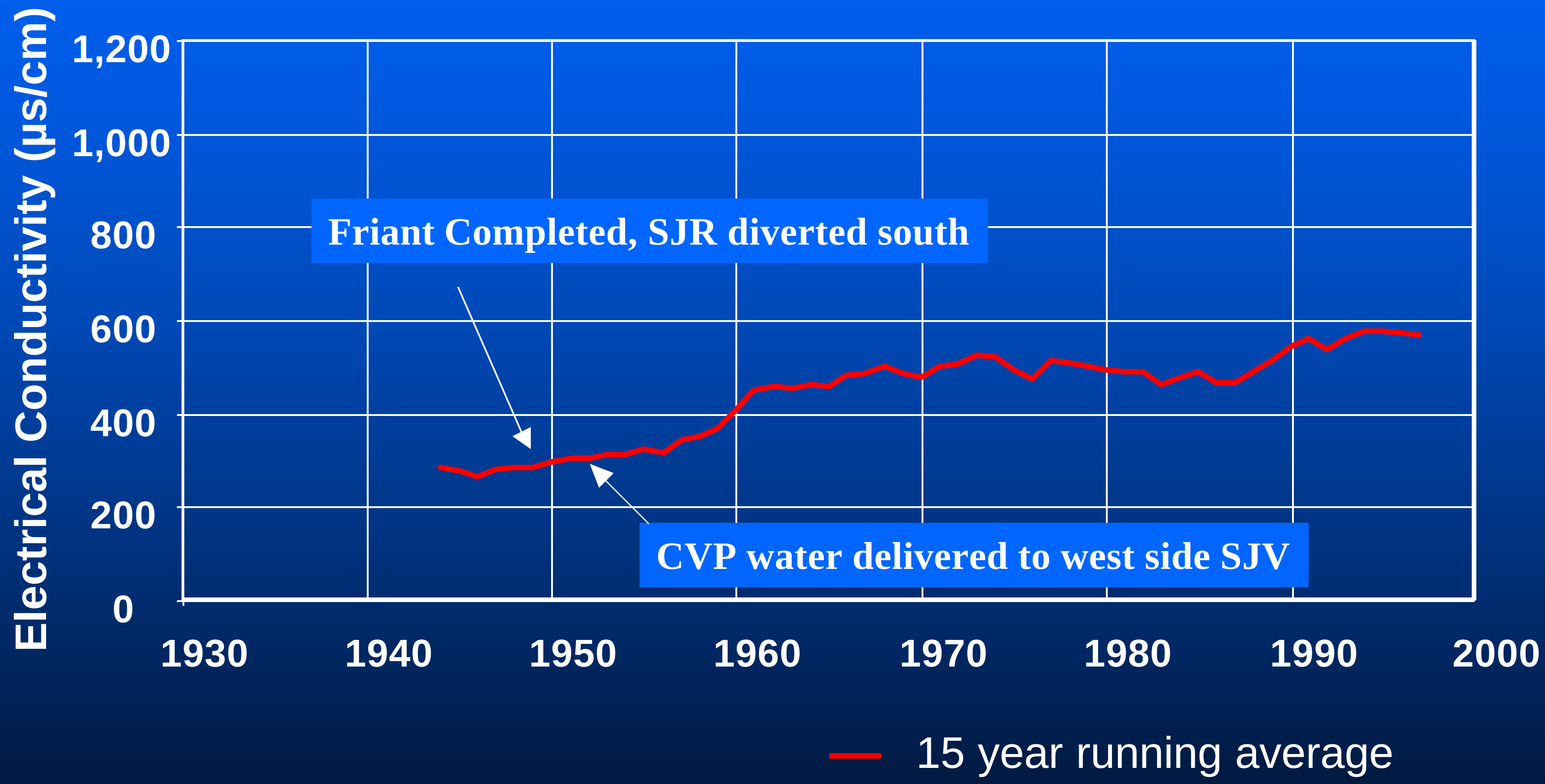
Lower San Joaquin River Basin



SJR Near Vernalis Mean Annual Electrical Conductivity



SJR Near Vernalis Mean Annual Electrical Conductivity



Current Salinity
Water Quality Objectives

In 1991, the SWRCB adopted the following water quality objective for electrical conductivity (EC) in the Bay-Delta Plan for the San Joaquin River at Airport Way Bridge near Vernalis:

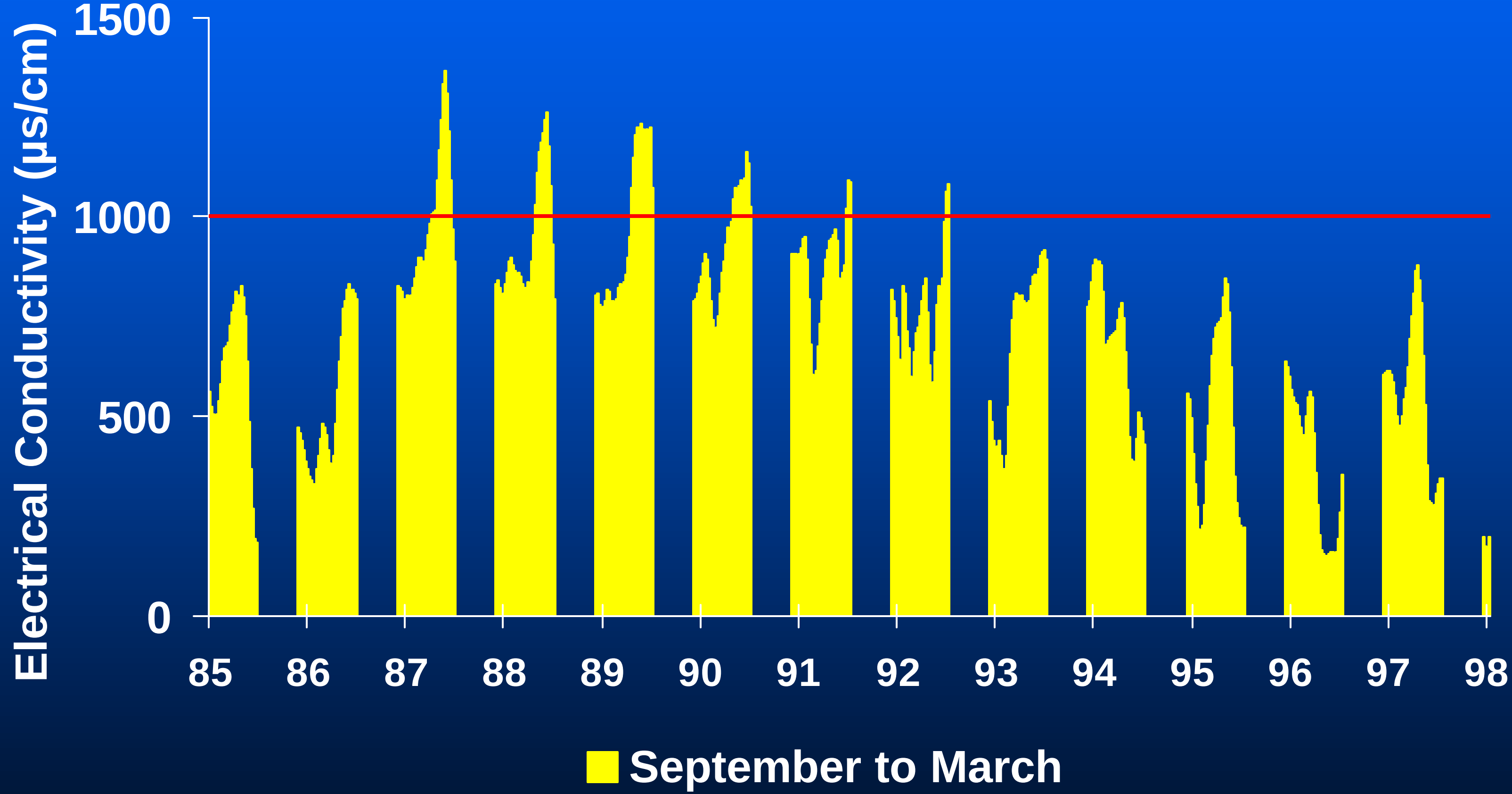
Objective (µs/cm)	Time Period
700	April through August
1,000	September through March

Current Boron Water Quality Objectives

Location Season	Mean Monthly Objective (mg/L)
Sack Dam to Merced River:	
15 March to 15 September	2.0 (or 5.8 maximum)
Merced River to Vernalis	
15 March to 15 September	0.8 (or 2.0 maximum)
16 September to 14 March	1.0 (or 2.6 maximum)
critical year / year round	1.3

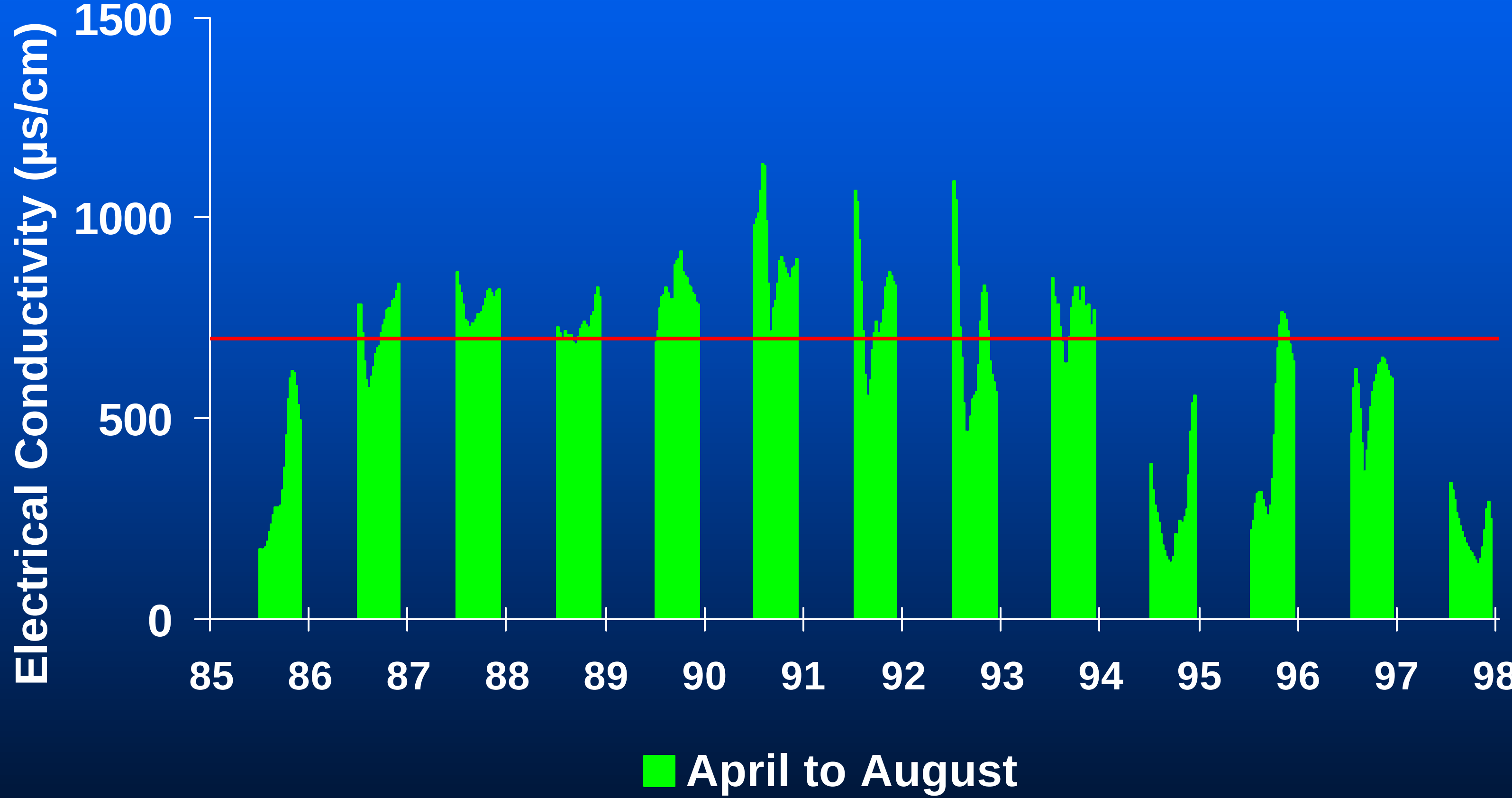
San Joaquin River near Vernalis

30 Day Running Average Electrical Conductivity



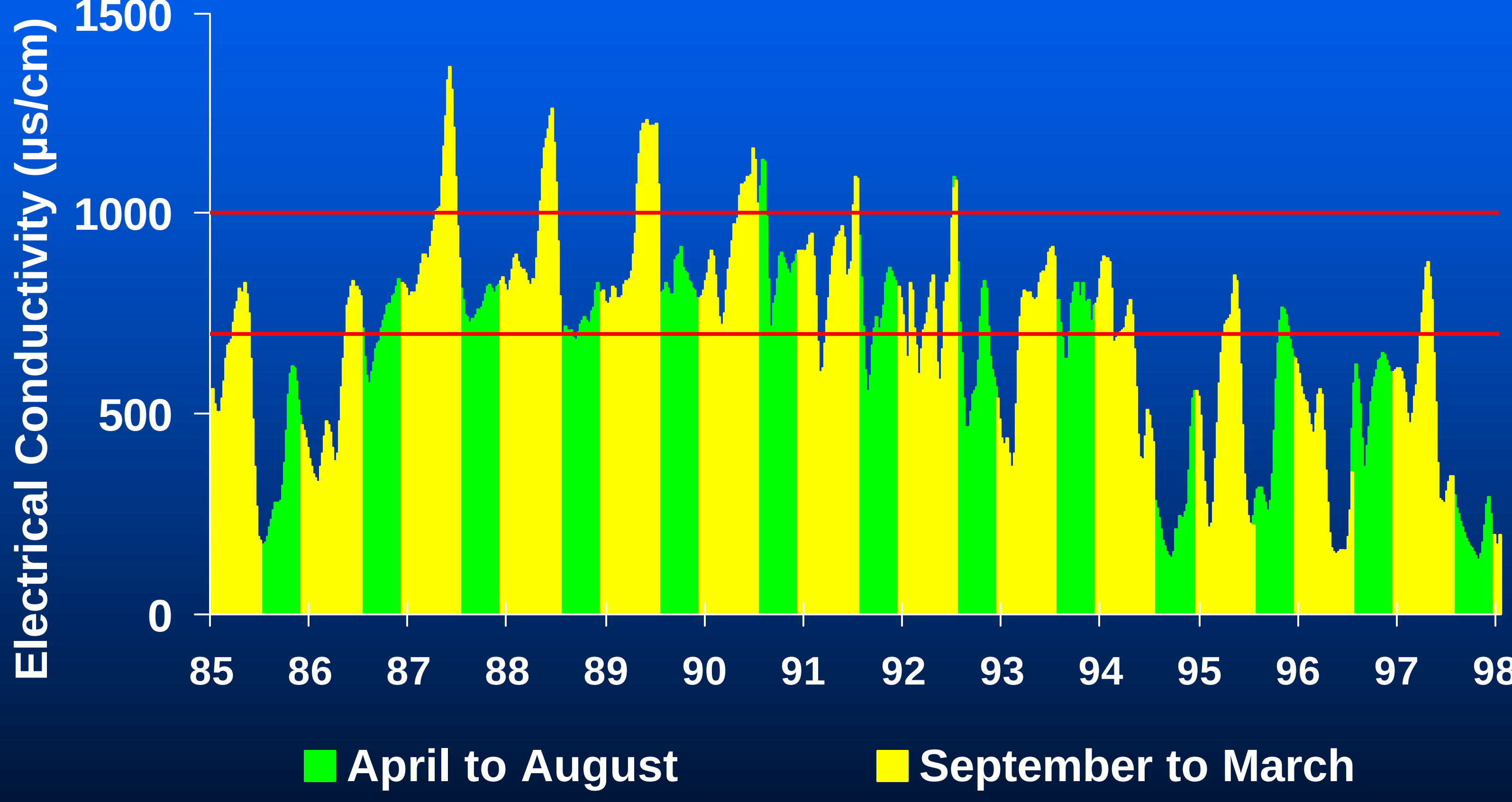
San Joaquin River near Vernalis

30 Day Running Average Electrical Conductivity



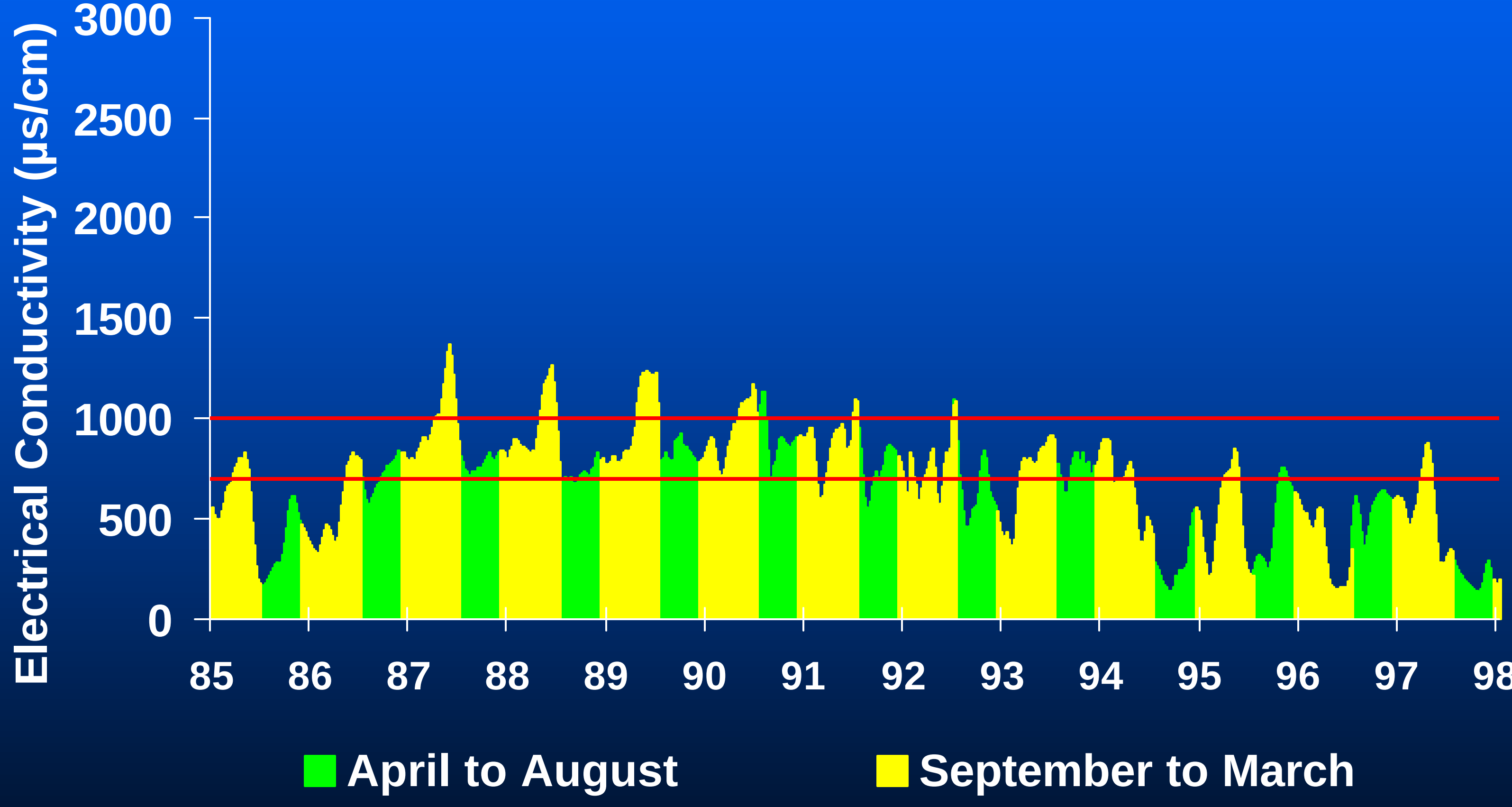
San Joaquin River near Vernalis

30 Day Running Average Electrical Conductivity



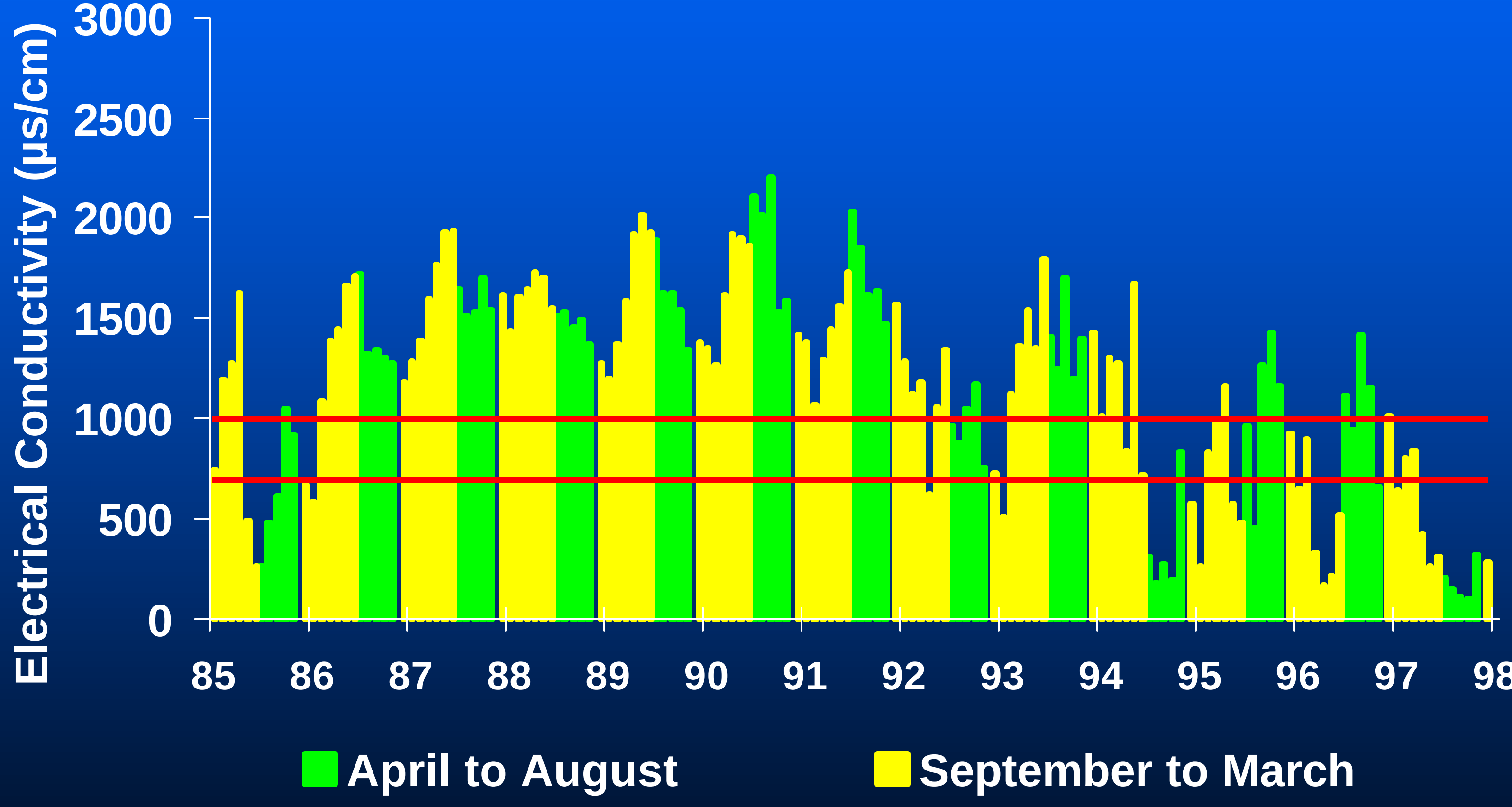
San Joaquin River near Vernalis

30 Day Running Average Electrical Conductivity



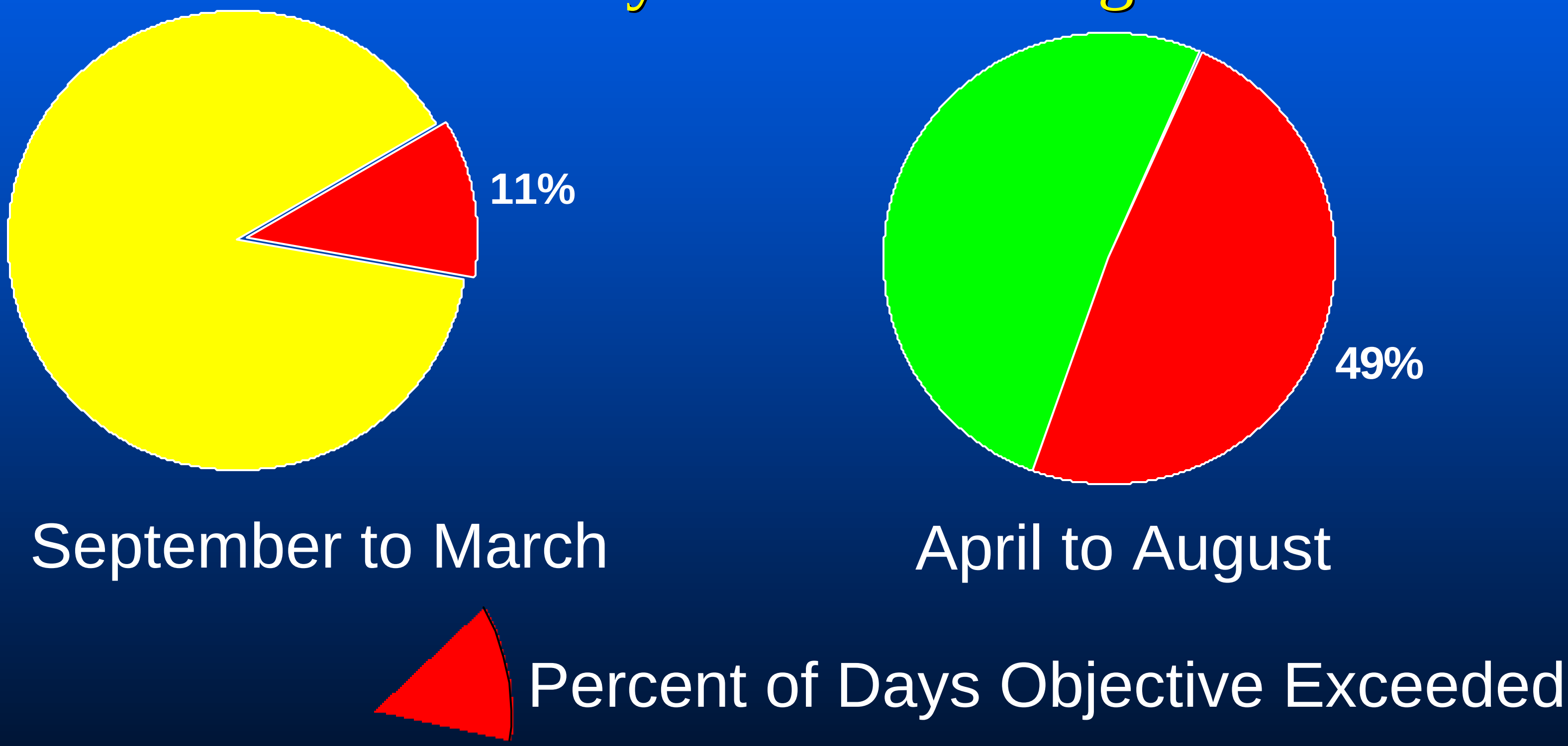
San Joaquin River at Crows Landing

Monthly Average Electrical Conductivity



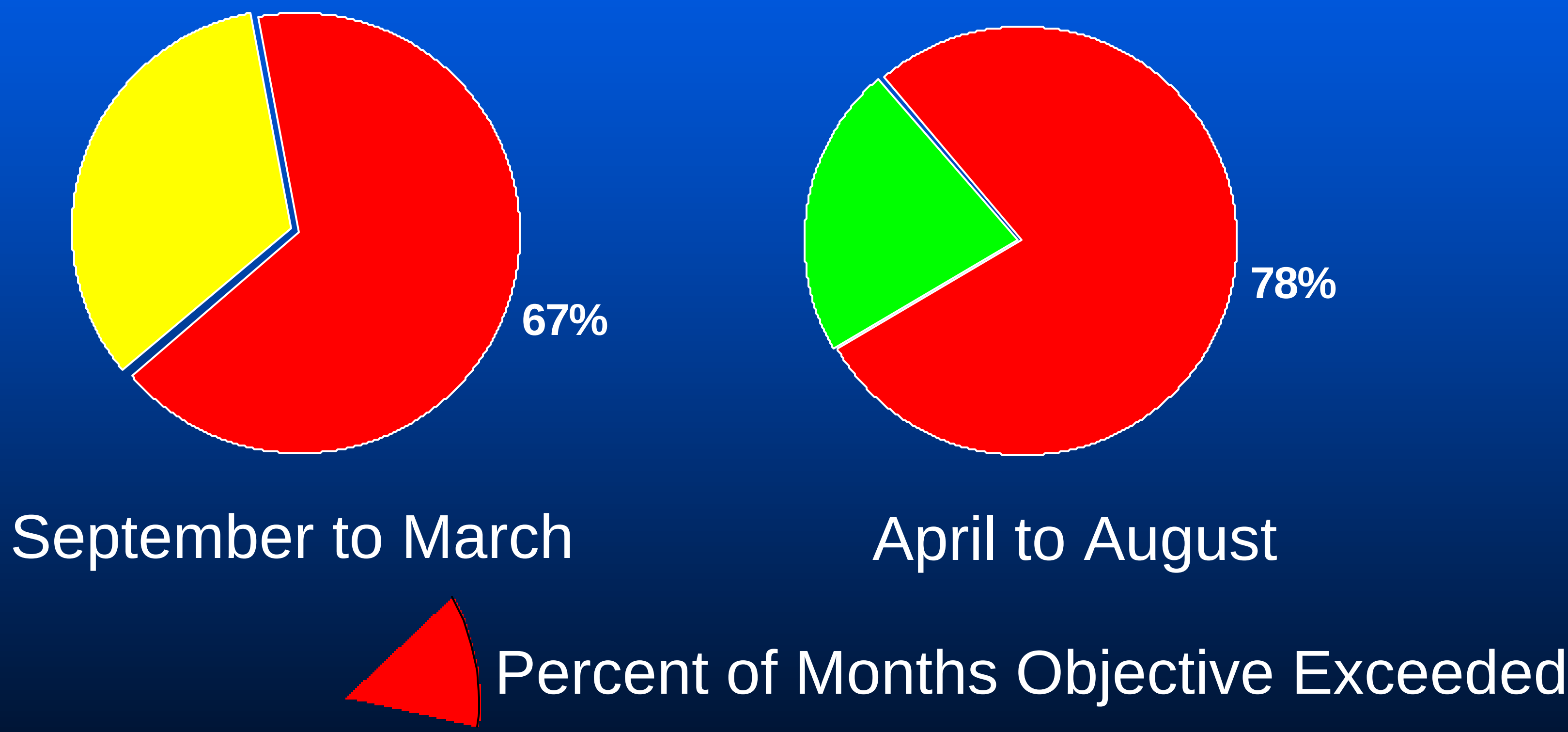
San Joaquin River near Vernalis

Percent of days that 30-day running average electrical conductivity objective has been exceeded from water year 1986 through 1998

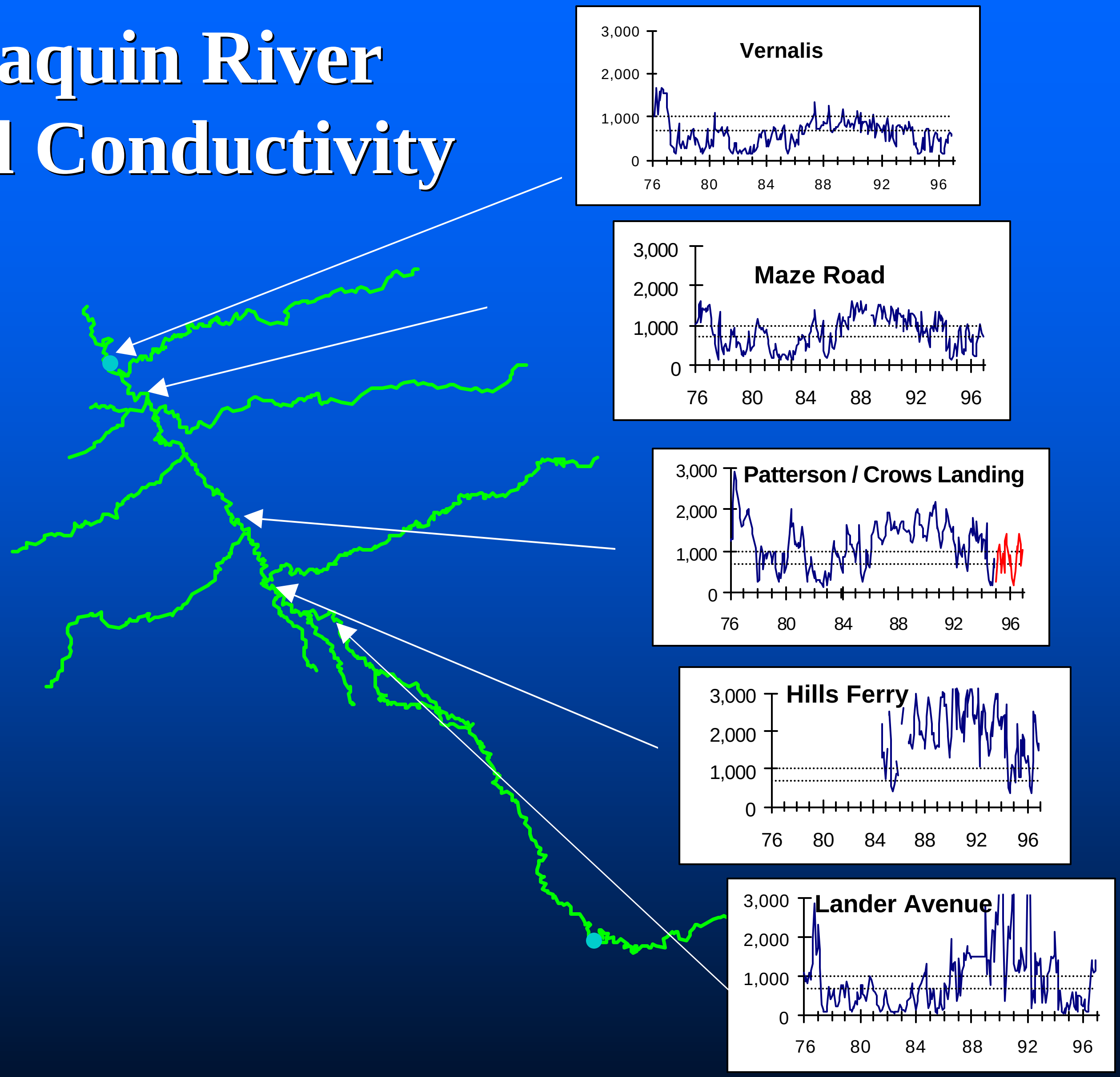


San Joaquin River at Crows Landing

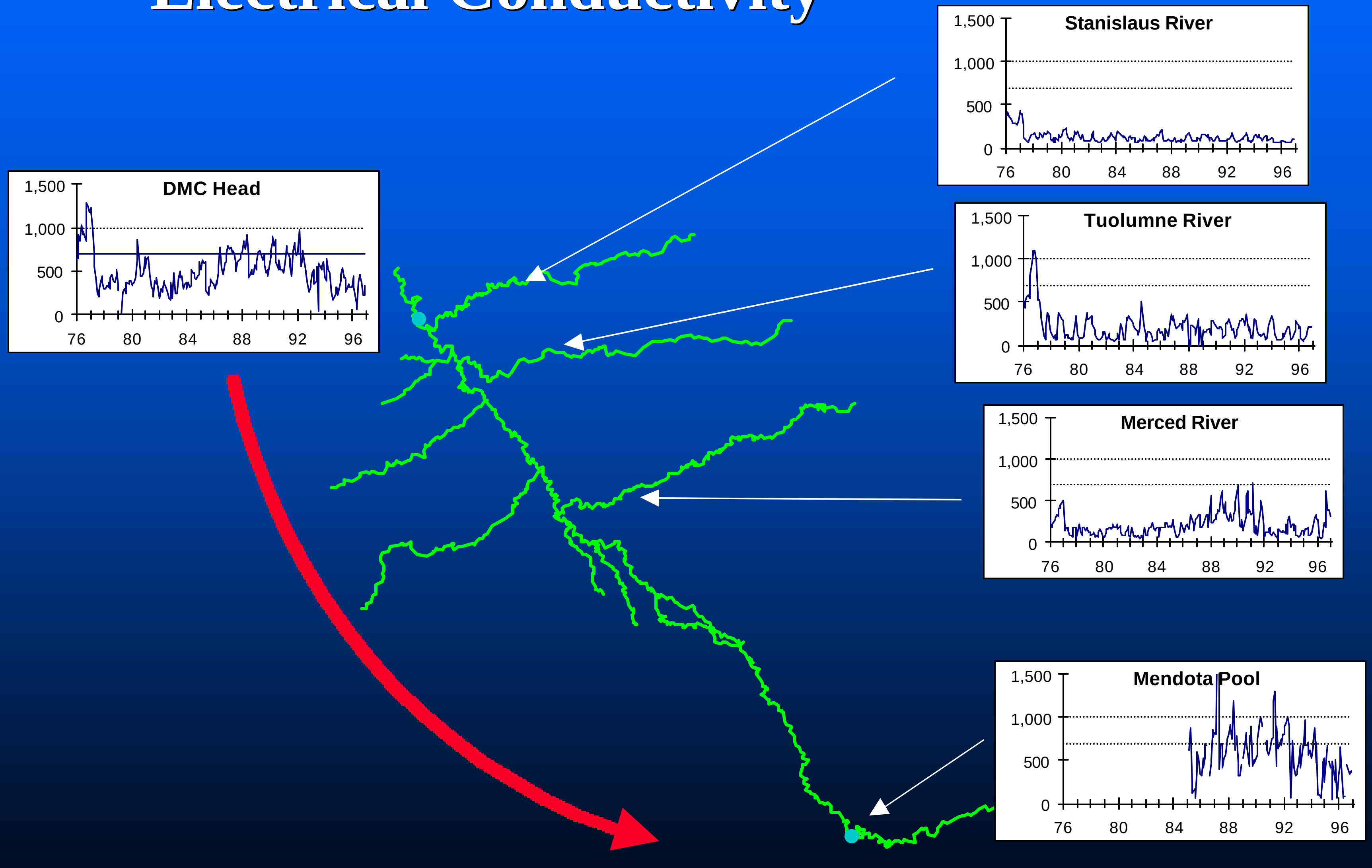
Percent of months that mean monthly electrical conductivity at Crows Landing exceeded Vernalis objectives from water year 1986 through 1998



San Joaquin River Electrical Conductivity

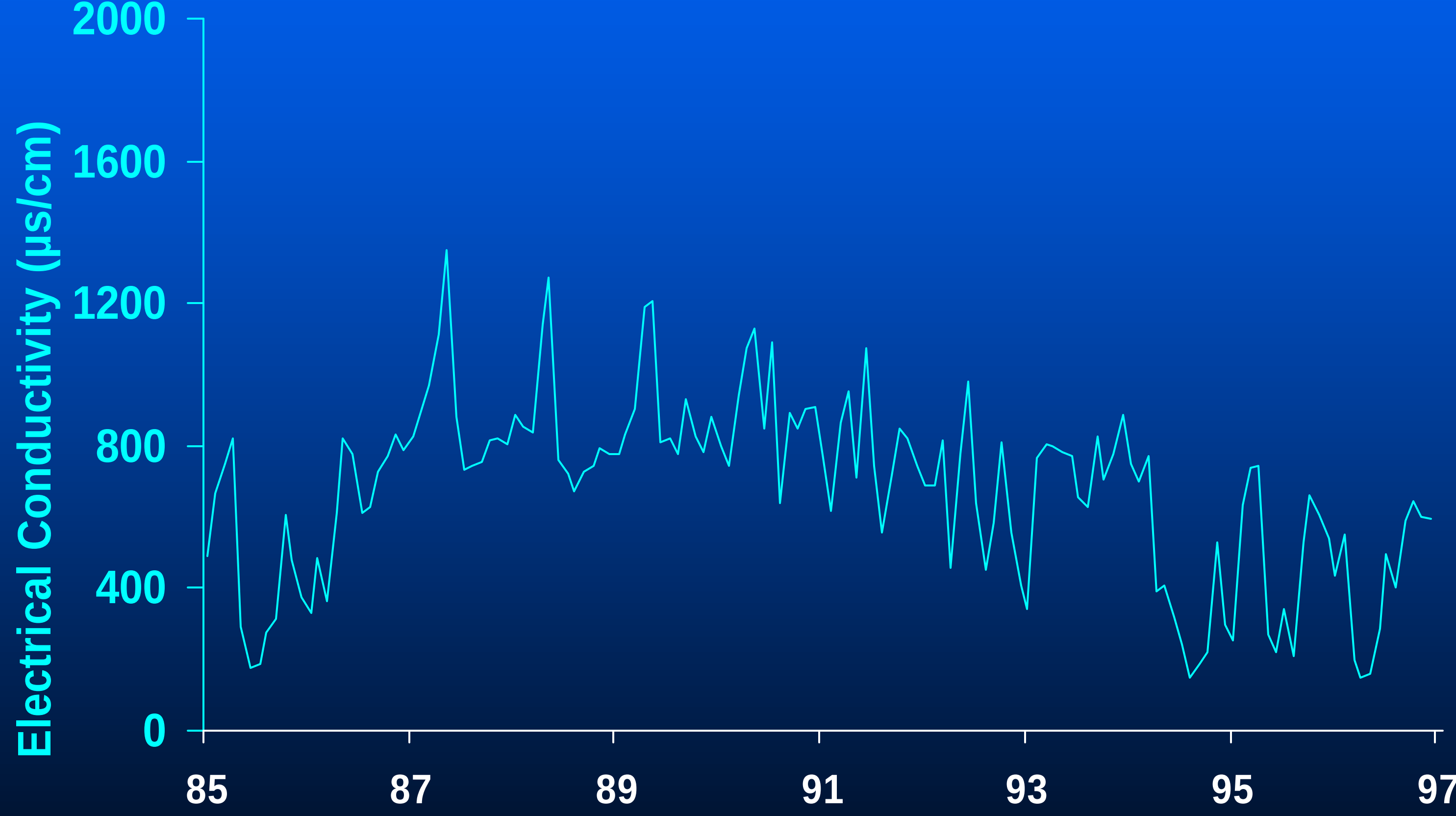


San Joaquin River Supply Water Electrical Conductivity



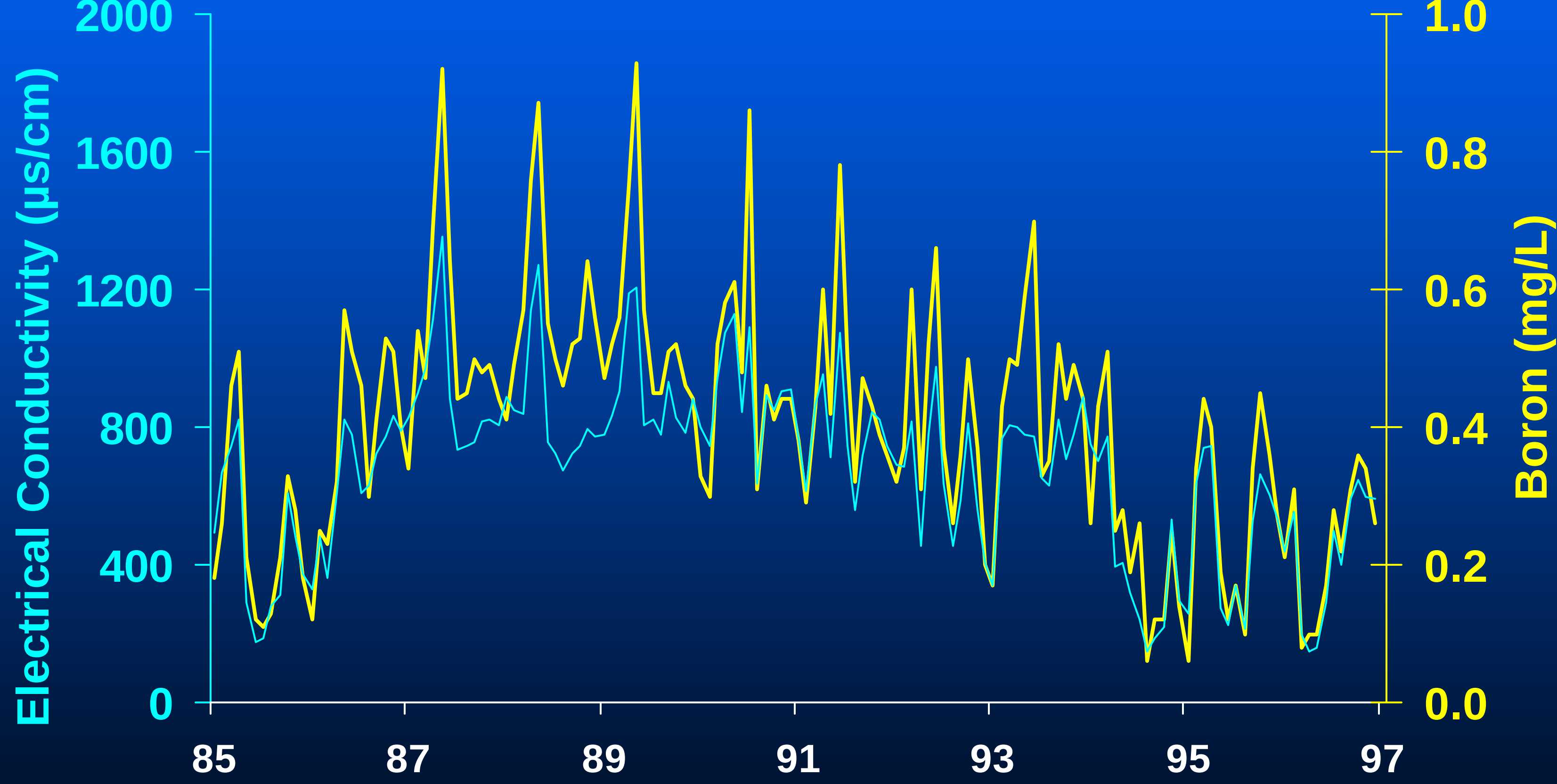
San Joaquin River near Vernalis

Electrical Conductivity and Boron Concentrations



San Joaquin River near Vernalis

Electrical Conductivity and Boron Concentrations

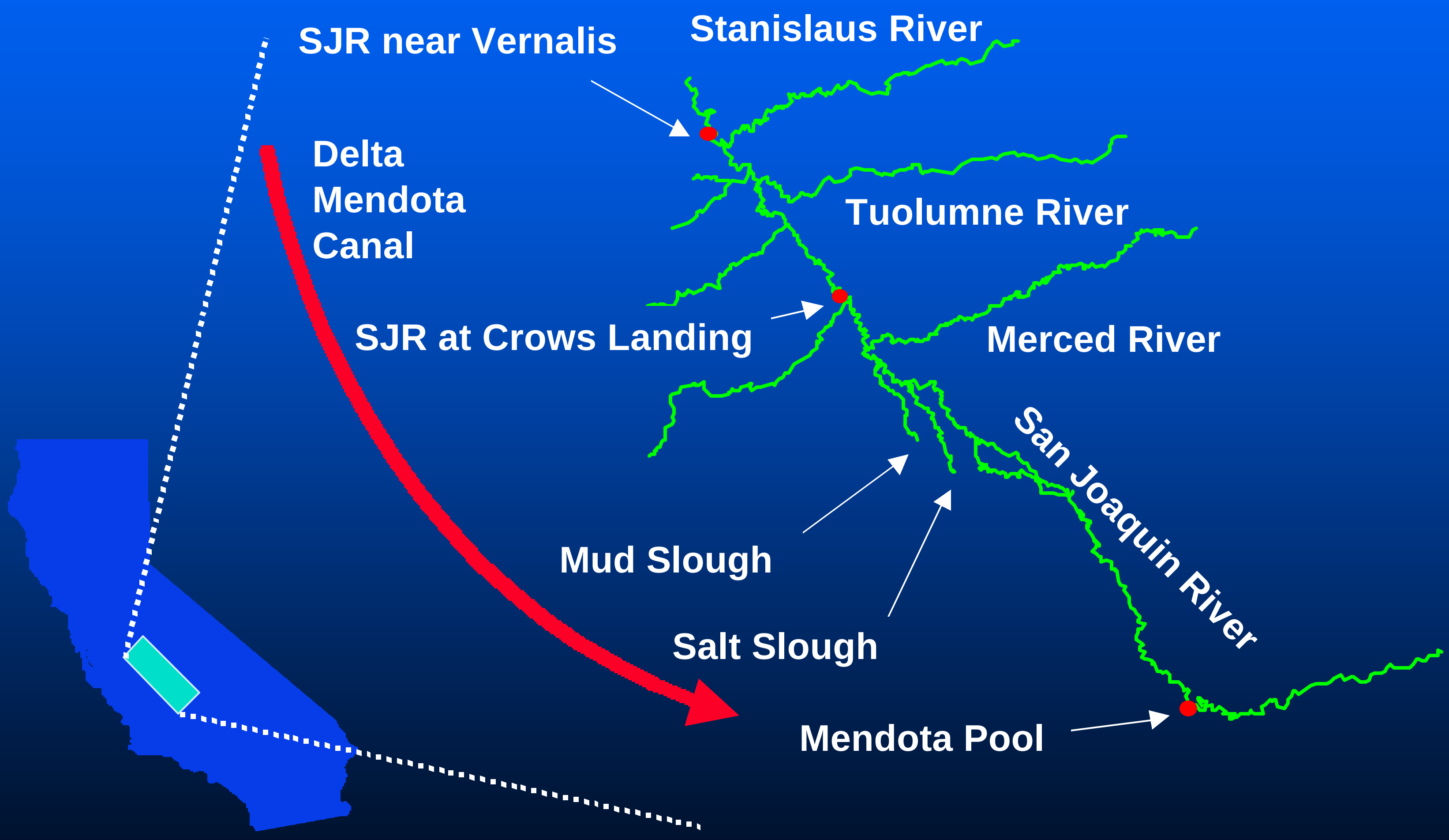


Water Quality is a function of...

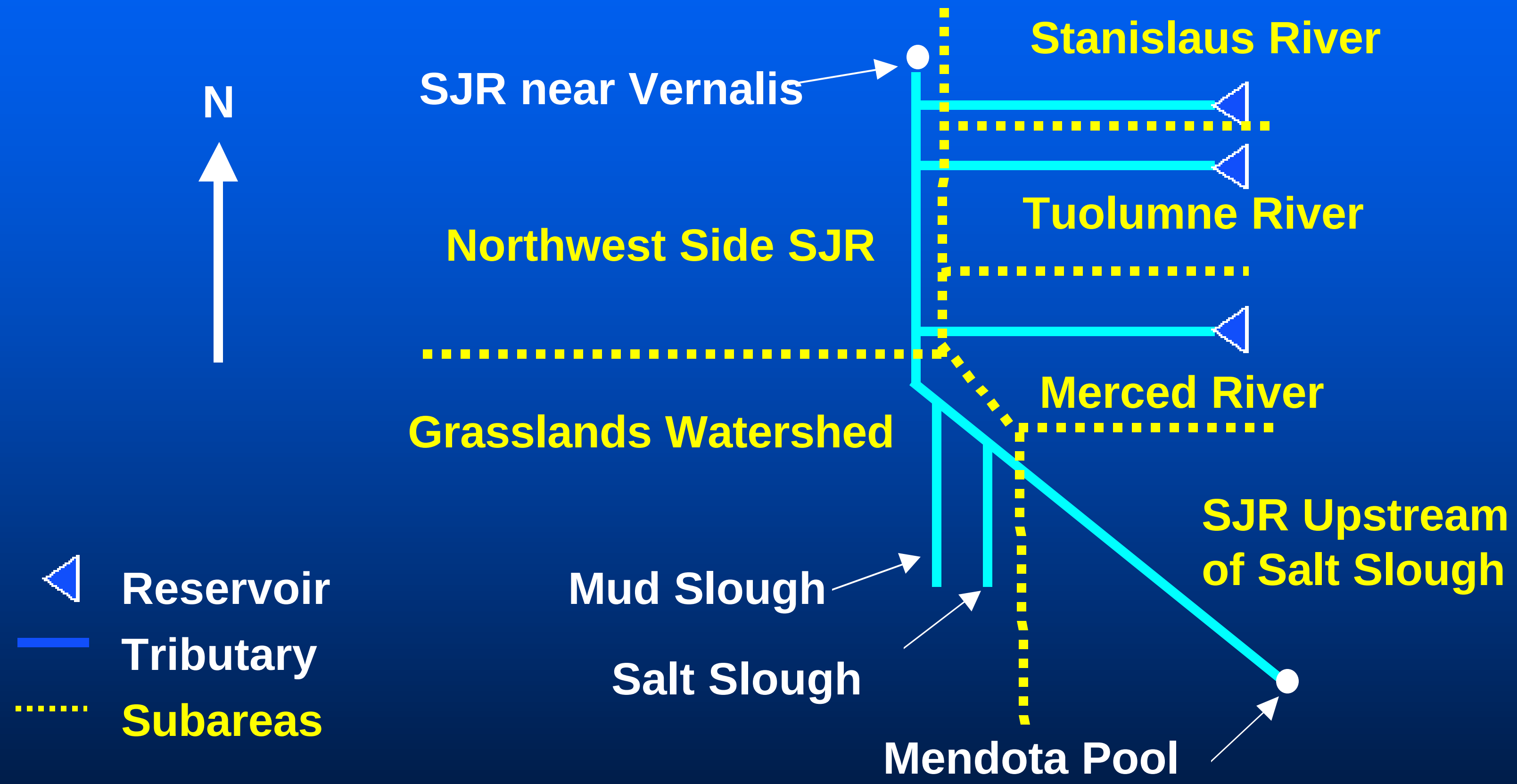
- Dilution flows
- Salt Loads

Where are salt and water coming from?

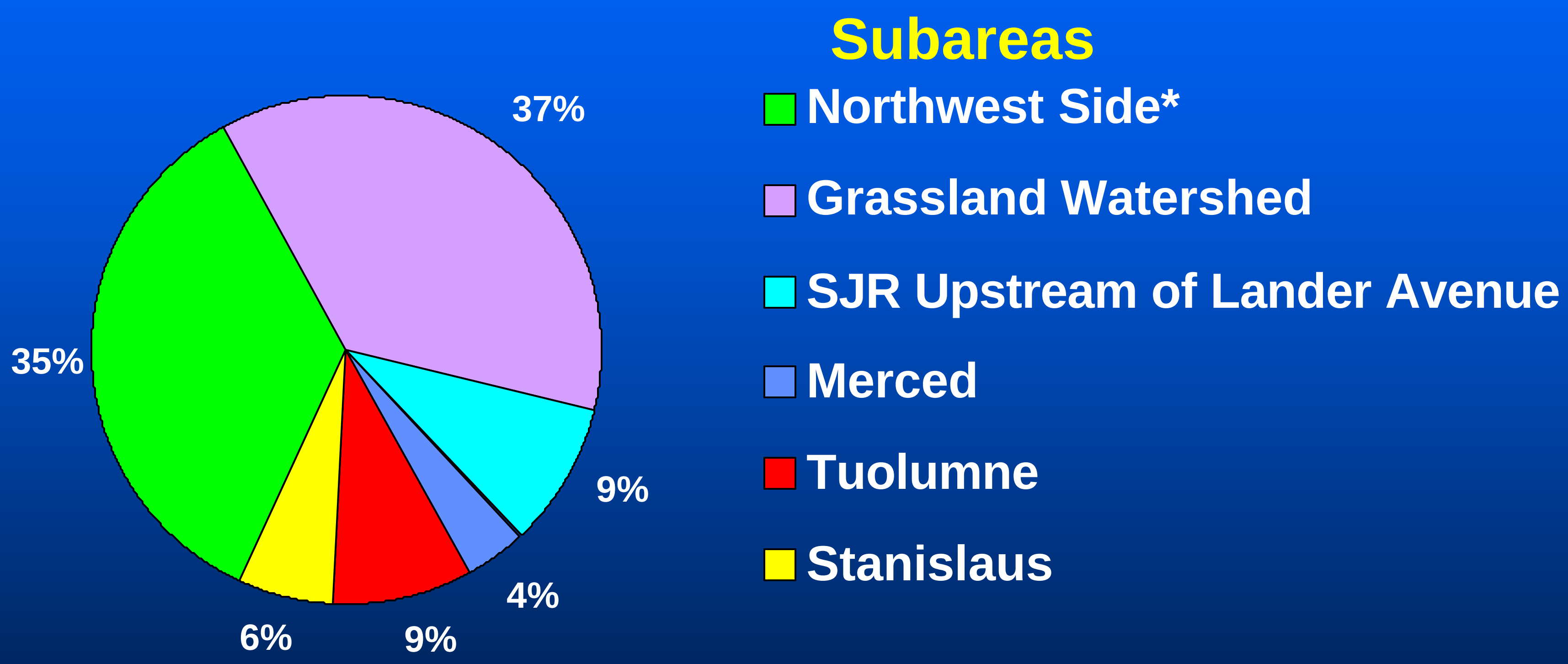
Lower San Joaquin River Basin



Lower San Joaquin River Basin Subareas



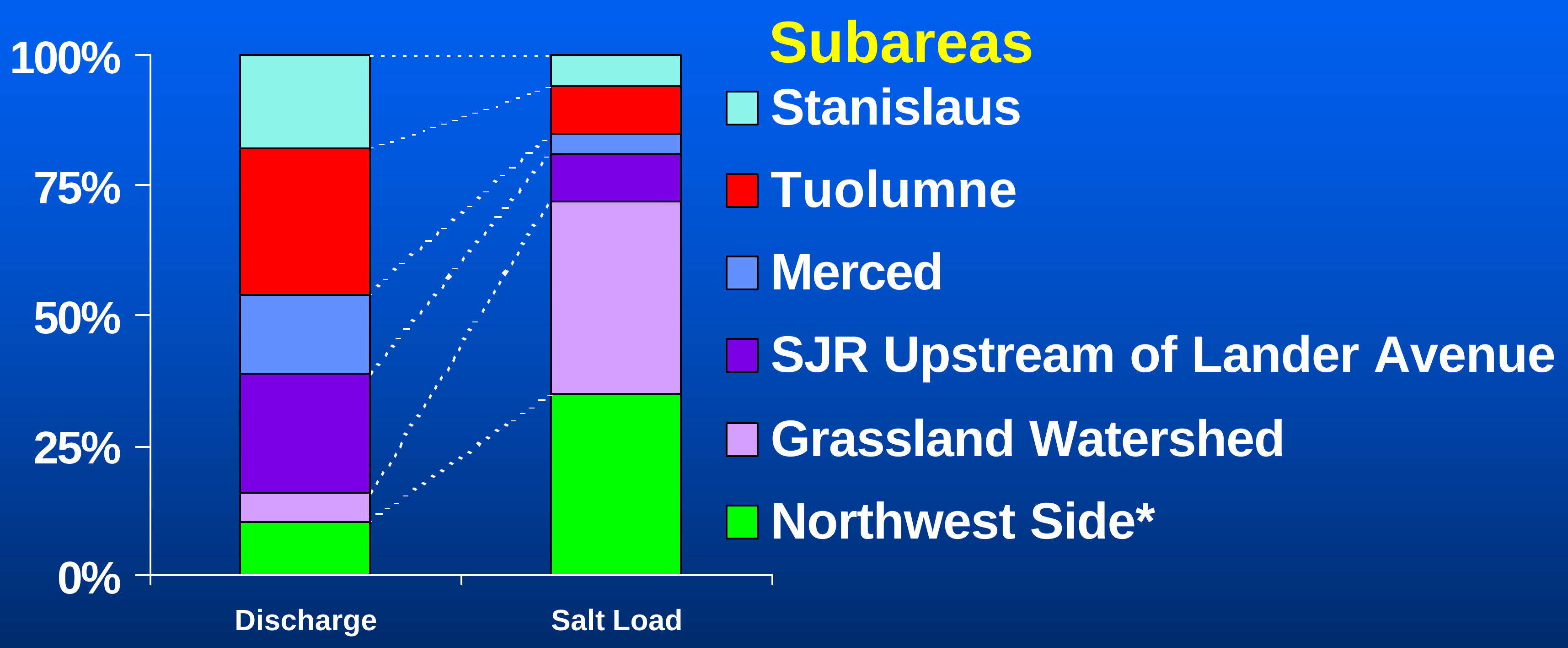
Sources of Salt (Geographic)



Mean Annual Salt Load to SJR for WY 1977 to 1997: 1.1 million tons

*Northwest Side estimated by difference :Vernalis minus sum of other sources

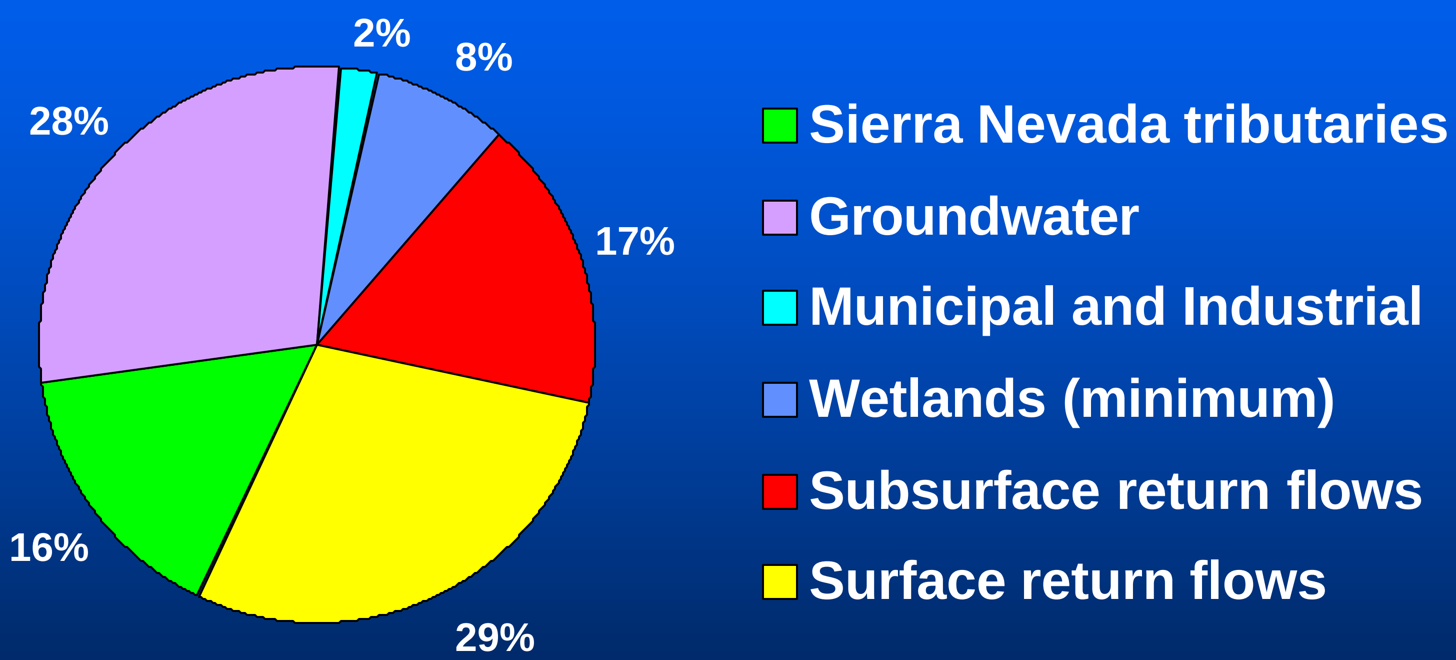
Geographic Sources of Discharge and Salt



WY 1977 to 1997: Mean Discharge: 3.7 million acre-feet,
Mean Annual Salt Load: 1.1 million tons

Basis: Historical data and spreadsheet analyses

Sources of Salt (by type)

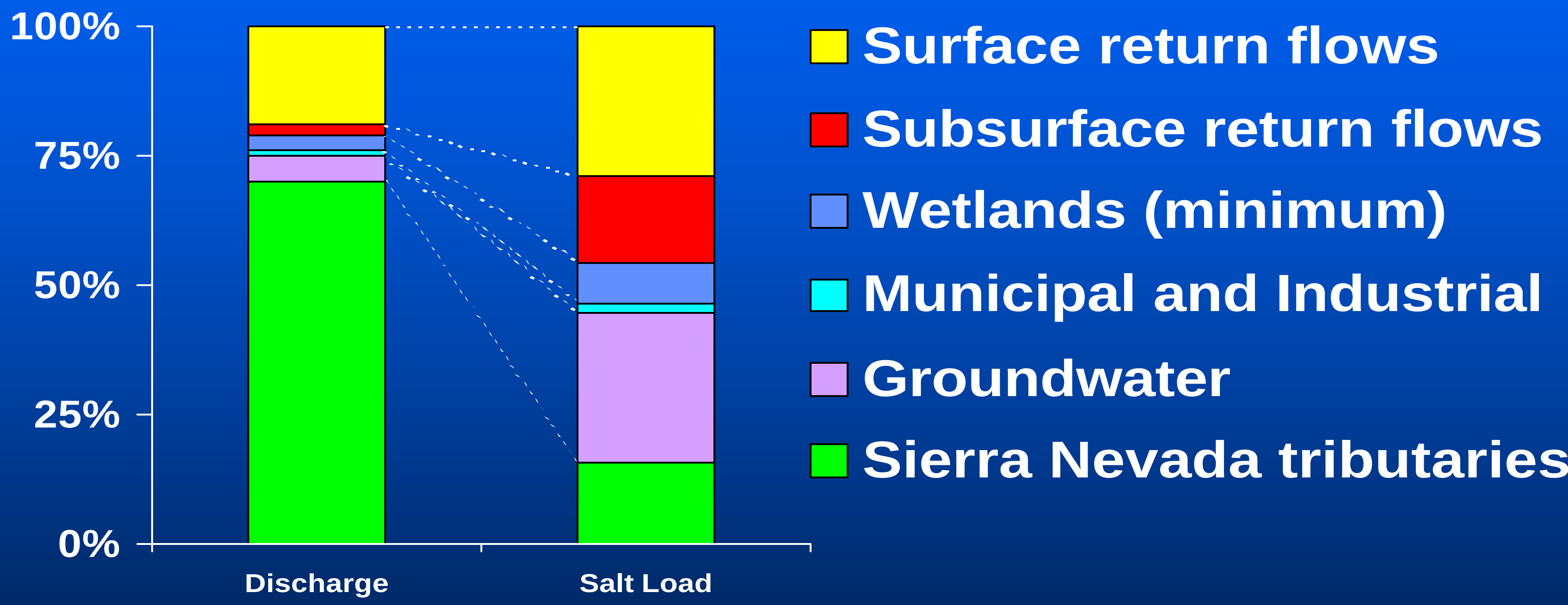


Mean Annual Loading of TDS to SJR for WY 1985 to 1994: 1 million tons

Basis: Historical and SJRIO* model data and spreadsheet analyses

*SJRIO: San Joaquin River Input Output Model

Type Sources of Discharge and Salt



WY 1985 to 1994: Mean Discharge: 1.9 million acre-feet,

Mean Annual Loading of TDS: 1 million tons

Basis: Historical and SJRIO* model data and spreadsheet analyses

*SJRIO: San Joaquin River Input Output Model

Lower San Joaquin River Basin Changing Conditions

- Vernalis Adaptive Management Plan (VAMP)
  - changing SJR flow patterns
- Grassland Bypass Project
  - decreased flow volume, decreased salt load, increased salt concentration
- Changing CVP Allocations
  - fluctuating agricultural water supply (limits on Delta pumping)
  - increased wetland deliveries in last decade (Central Valley Project Improvement Act)
- Increased Agricultural Water Use Efficiency
  - water transfers, decreased return flows
- Increased use of Subsurface Agricultural Drains
  - increased salt load to SJR

Questions

- Is this an accurate representation of current water quality conditions?
- What can you do?
  - keep in touch
    - » help us update our mailing list
  - comment
    - » review draft reports
    - » discuss locally

Water Quality Objectives for Salinity and Boron

San Joaquin River
Basin Plan Amendment Addressing
Salinity and Boron

Water Quality Objectives Topics

- State and Federal Laws
- Effects of Salinity on Beneficial Uses
- Salinity Alternatives
- Effects of Boron on Beneficial Uses
- Boron Alternatives
- Questions and Comments

Why Evaluate Water Quality Objectives for Boron and Salt?

- Directed by State Board Bay-Delta Plan
- Boron Objectives Not US EPA Approved
- Impaired Water Body

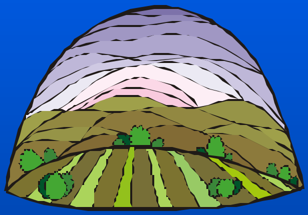
State Laws and Policies for Setting Objectives

- Beneficial Uses
- Environmental Characteristics
- Reasonably Achievable
- Economic Considerations
- Need for Housing & Recycled Water
- Sources of Drinking Water Policy
- Antidegradation Policy

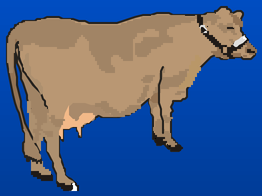
Federal Laws and Polices

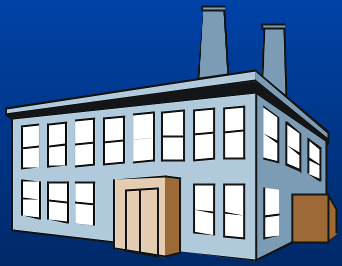
- Latest Scientific Knowledge
- Protect Designated (Beneficial) Uses
- Concentration and Disposal of Pollutants
- Effects on Human Health and Welfare
- Effects of Pollutants on Biology
- Antidegradation Policy

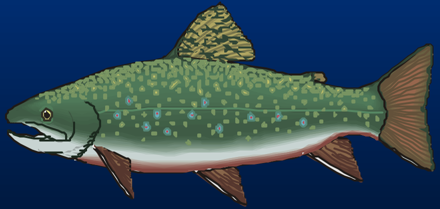
Beneficial Uses of the Lower San Joaquin River

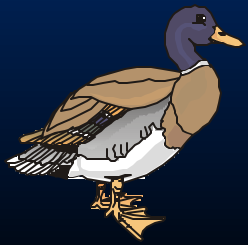


- Municipal and Domestic Supply
- Irrigation Water Supply
- Spawning, Reproduction, and/or Early Development
- Stock Watering
- Industrial Process Supply
- Recreation
- Freshwater Habitat
- Migration
- Wildlife









Salinity

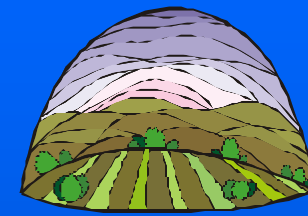
- Dissolved Mineral Concentrations in Water
- Combination of Various Salts in Solution
- Typically Measured As:
  - Electrical Conductivity (EC)
  - Total Dissolved Solids (TDS)

Drinking Water
EC (micromhos/cm)

State Drinking Water Secondary MCL

Recommended	900
Upper Level	1,600
Short Term	2,200

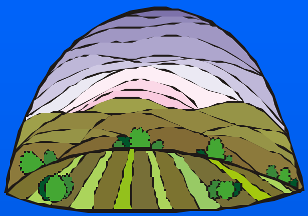
Irrigated Agriculture
EC_w (micromhos/cm)



Ranges of Crop Sensitivity to Salinity

■ Sensitive Crops	under 1,000
■ Moderately Sensitive	1,000 to 2,100
■ Moderately Tolerant	2,100 to 4,200
■ Tolerant	4,200 to 6,800
■ Unacceptable	over 6,800

Irrigated Agricultural
Salt Sensitive Crops



- Sensitive Crops Include:

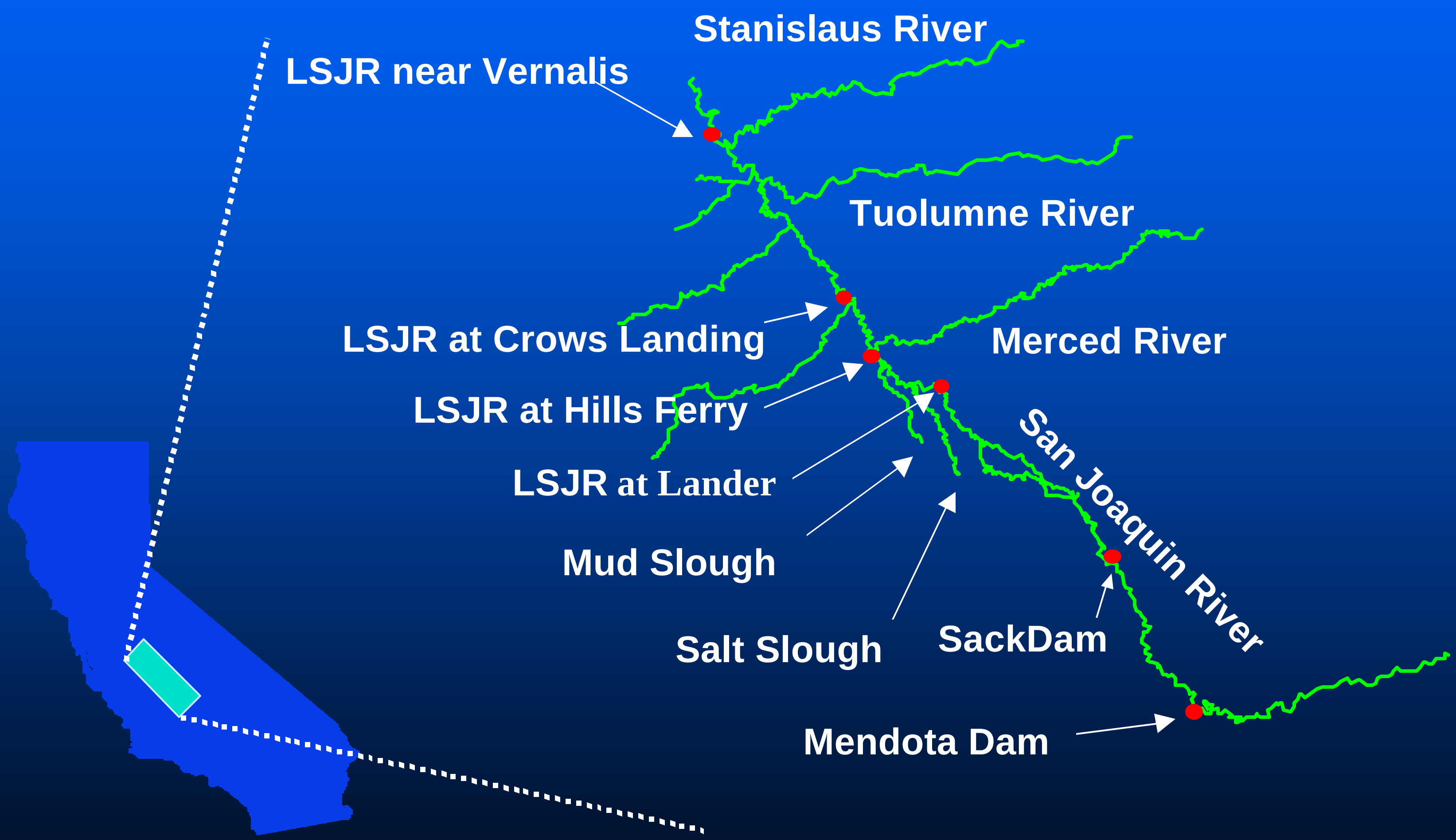
  Beans, Rice, Carrots, Onions, Peas, Almonds, Apples, Apricots
- Moderately Sensitive Crops Include:

  Alfalfa, Corn, Broccoli, Tomatoes, Lettuce, Grapes

Alternative Water Quality Objectives for Salinity

- No Action
- Full Protection
- Delta Export

Lower San Joaquin River Basin



Salinity
No Action Alternative
EC (micromhos/cm)

State Board Vernalis Objective:

April through August	**700**
September through March	**1,000**

Secondary Drinking Water MCL:

Recommended	**900**
Upper Level	**1,600**

Salinity
Full Protection Alternative
EC (micromhos/cm)

State Board Vernalis Objective:

April through August	**700**
September through March	**1,000**

Mendota Dam to Vernalis

April through August	**700**
September through March	**900**

Salinity
Delta Export Alternative
EC (micromhos/cm)

State Board Vernalis Objective:

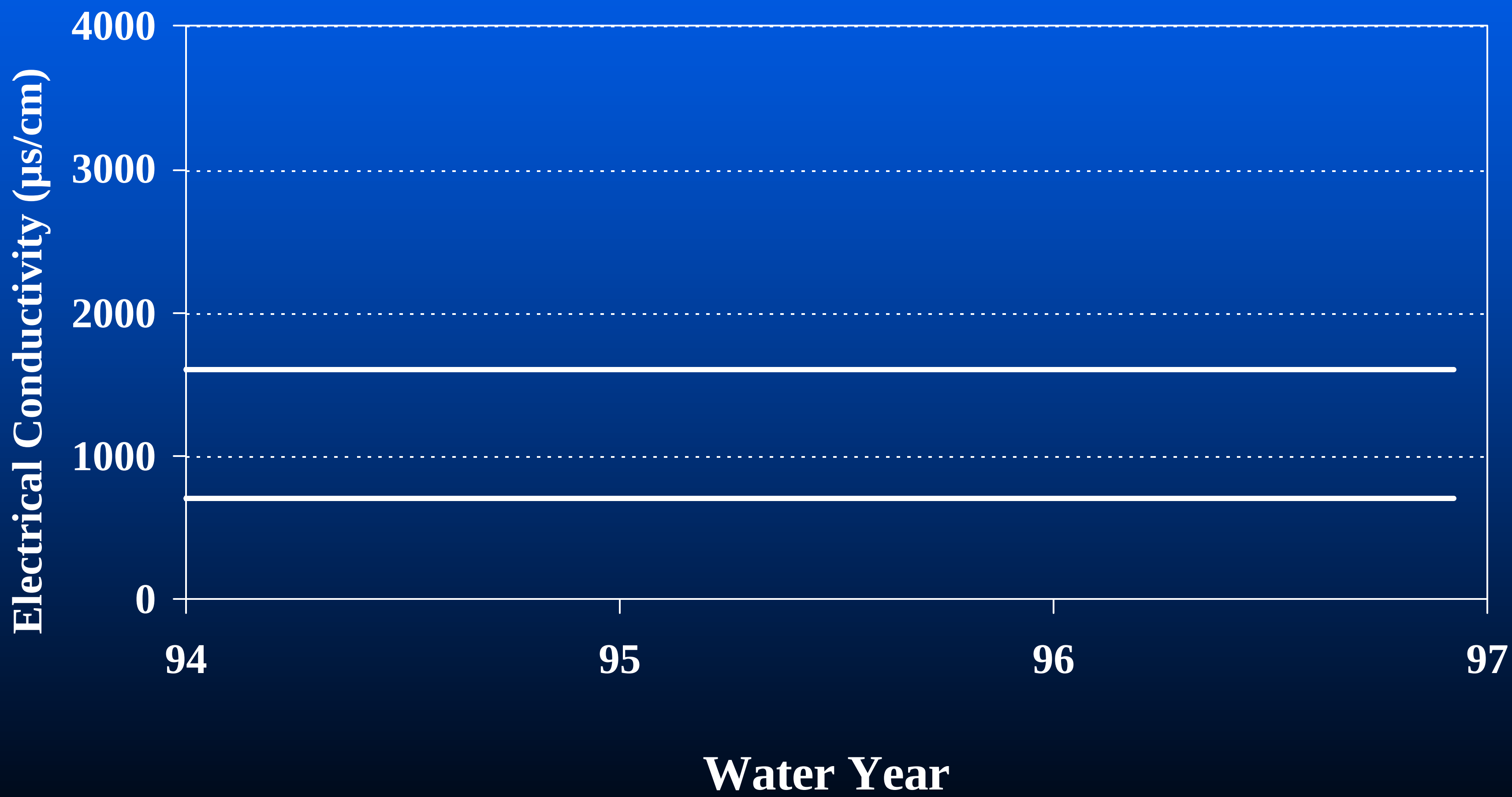
April through August	**700**
September through March	**1,000**

Mendota Dam to Vernalis

Year Around	**1,000**

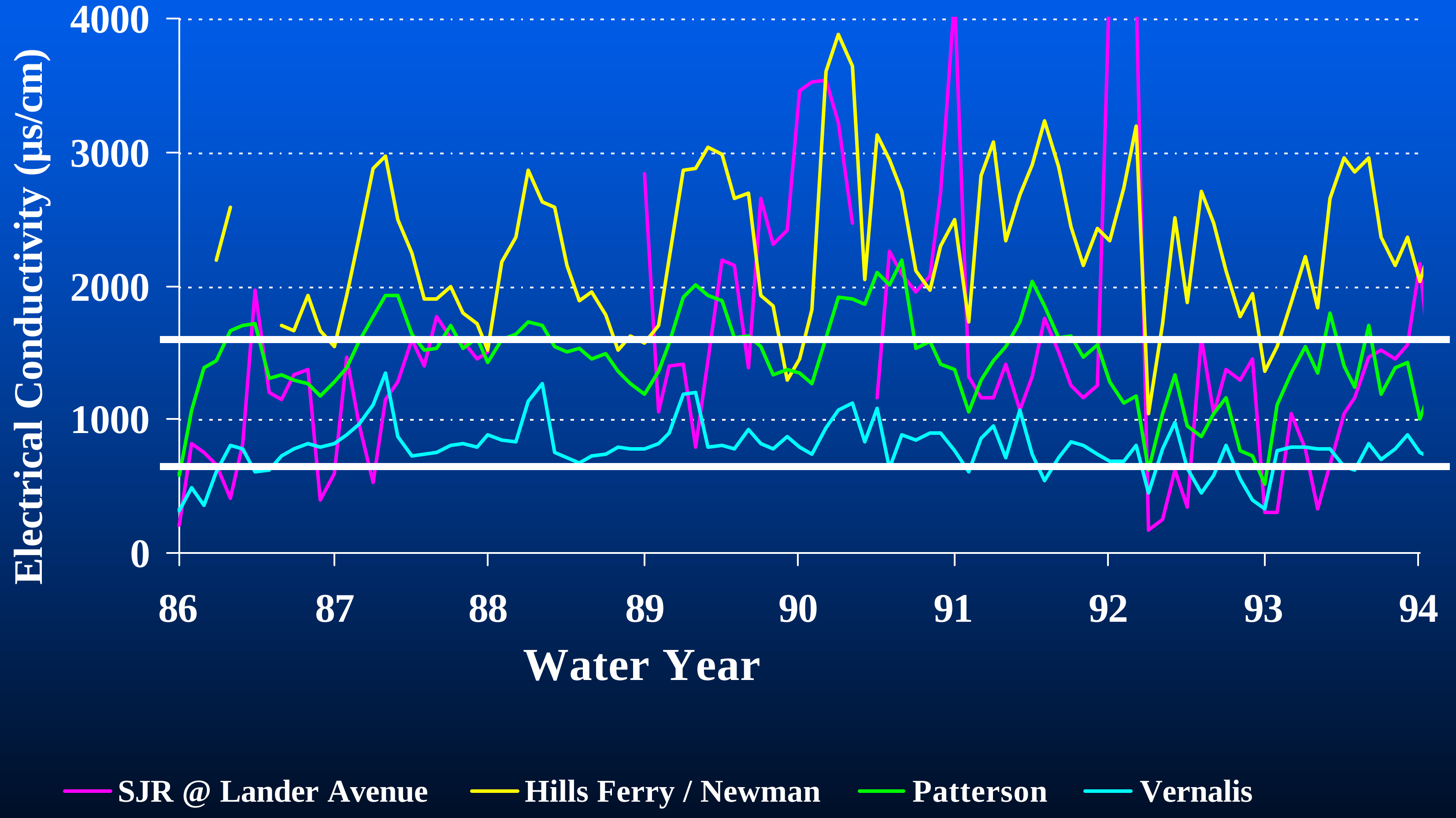
Range of Alternative Electrical Conductivity Objectives

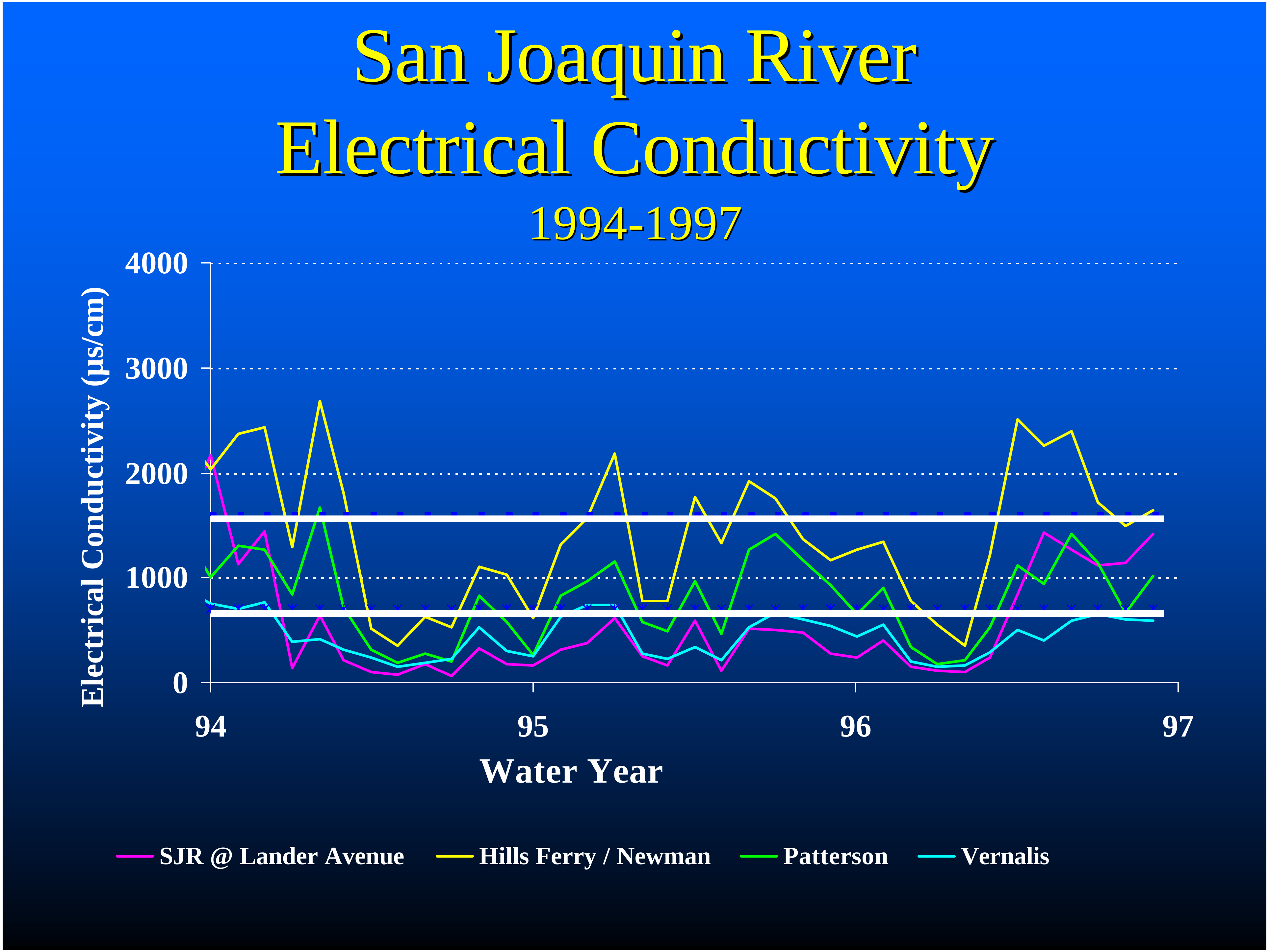
(700-1600 micromhos/cm)



San Joaquin River Electrical Conductivity

1986-1994



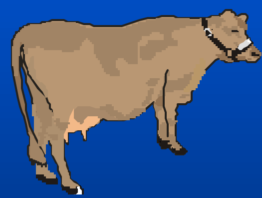

San Joaquin River
Electrical Conductivity
1994-1997
4000
3000
2000
1000
0
Electrical Conductivity (µs/cm)
94
95
96
97
Water Year
SJR @ Lander Avenue
Hills Ferry / Newman
Patterson
Vernalis

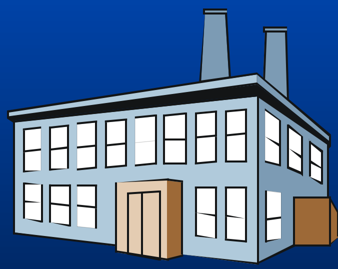
Boron

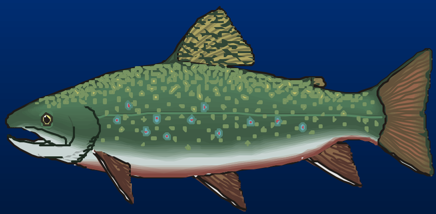
- Element Found in Nature
- Common in the Arid Western USA
- Measured as Total Dissolved Boron, mg/L

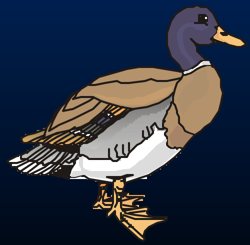
Effects of Boron on Beneficial Uses

- Municipal and Domestic Supply
- Irrigation Water Supply
- Spawning, Reproduction, and/or Early Development
- Stock Watering
- Industrial Process Supply
- Recreation
- Freshwater Habitat
- Migration
- Wildlife









Drinking Water
Boron (mg/L)

US EPA

IRIS Reference Dose	0.63
SNARL	0.60

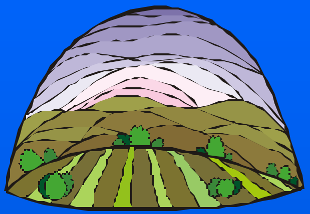
State Department of Health Services

Action Level	1.0

Irrigated Agriculture Boron (mg/L)

Very Sensitive	under 0.5
Sensitive Crops	0.5 to 1.0
Moderately Sensitive	1.0 to 2.0
Moderately Tolerant	2.0 to 4.0
Tolerant	4.0 to 6.0
Very Tolerant	6.0 to 15.0

Irrigated Agricultural
Boron Sensitive Crops



Very Sensitive Crops Include:

- Blackberry, Lemon

Sensitive Crops Include:

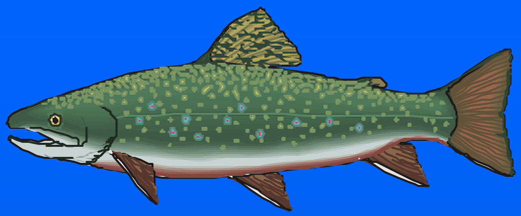
- Apricot, Cherry, Grape, Walnut,
- Beans, Strawberry, Wheat

Moderately Sensitive Crops Include:

- Broccoli, Carrot, Lettuce, Pea, Red Pepper, Radish

Fish

Boron (mg/L)



- Rainbow Trout (Steelhead) Embryo Development 0.75 to 1.0
- Catfish 22 to 155
- Salmon over 100

Summary of Effects on Most Sensitive Beneficial Uses
Boron (mg/L)

Drinking Water SNARL	0.60
Sensitive/Mod. Sensitive Crops	0.5 to 2.0
Rainbow Trout Embryos	0.75 to 1.0

Alternative Water Quality Objectives for Boron

- No Action
- Full Protection

No Action Alternative Boron (mg/L)

Location Season	Mean Monthly Objective (mg/L)
Sack Dam to Merced River:	
15 March to 15 September	2.0 (or 5.8 maximum)
Merced River to Vernalis	
15 March to 15 September	0.8 (or 2.0 maximum)
16 September to 14 March	1.0 (or 2.6 maximum)
Critical Year / Year Around	1.3

Full Protection Alternative for Boron (mg/L)

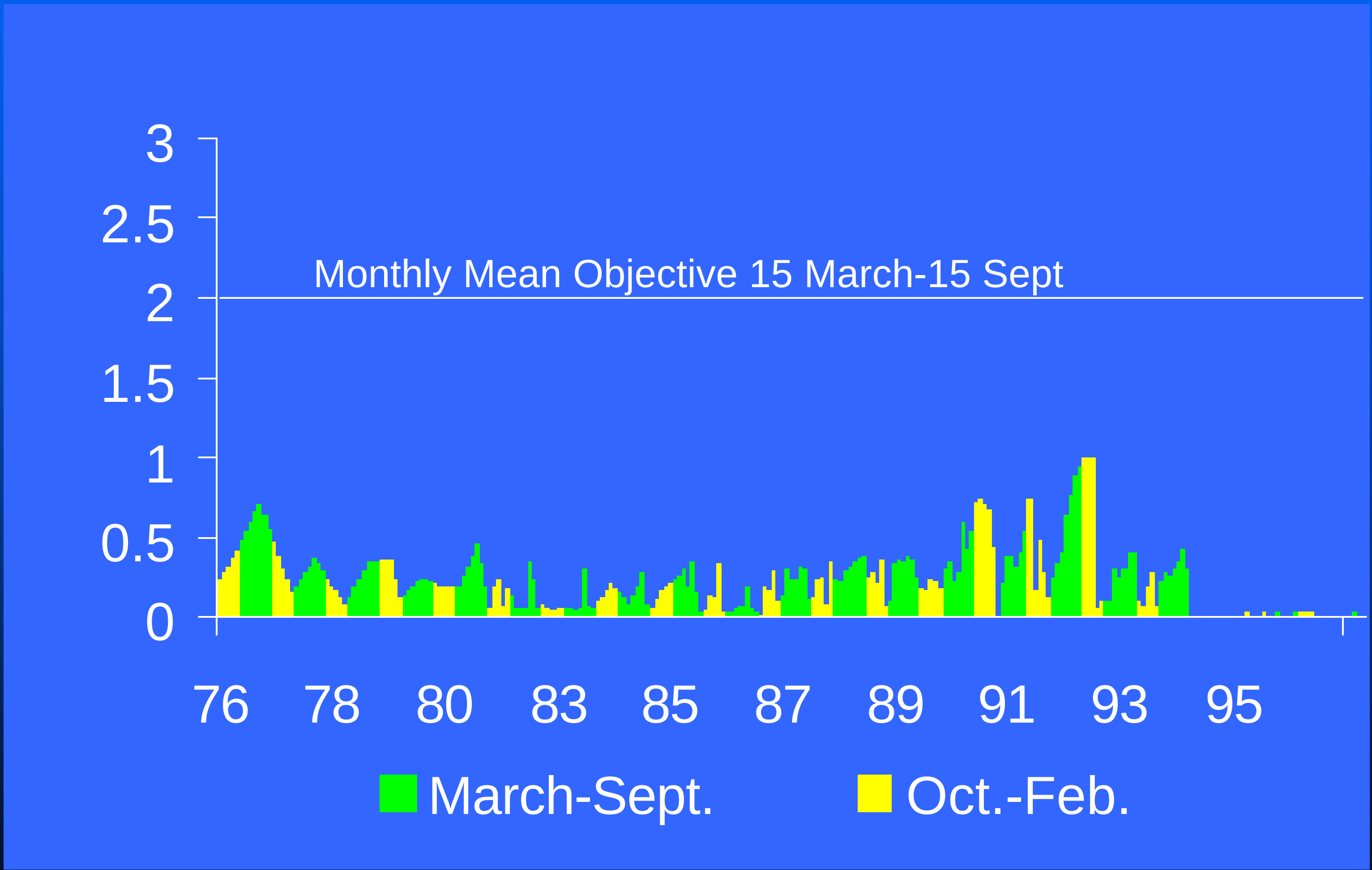
Mendota Dam to Vernalis

Four-Day Average

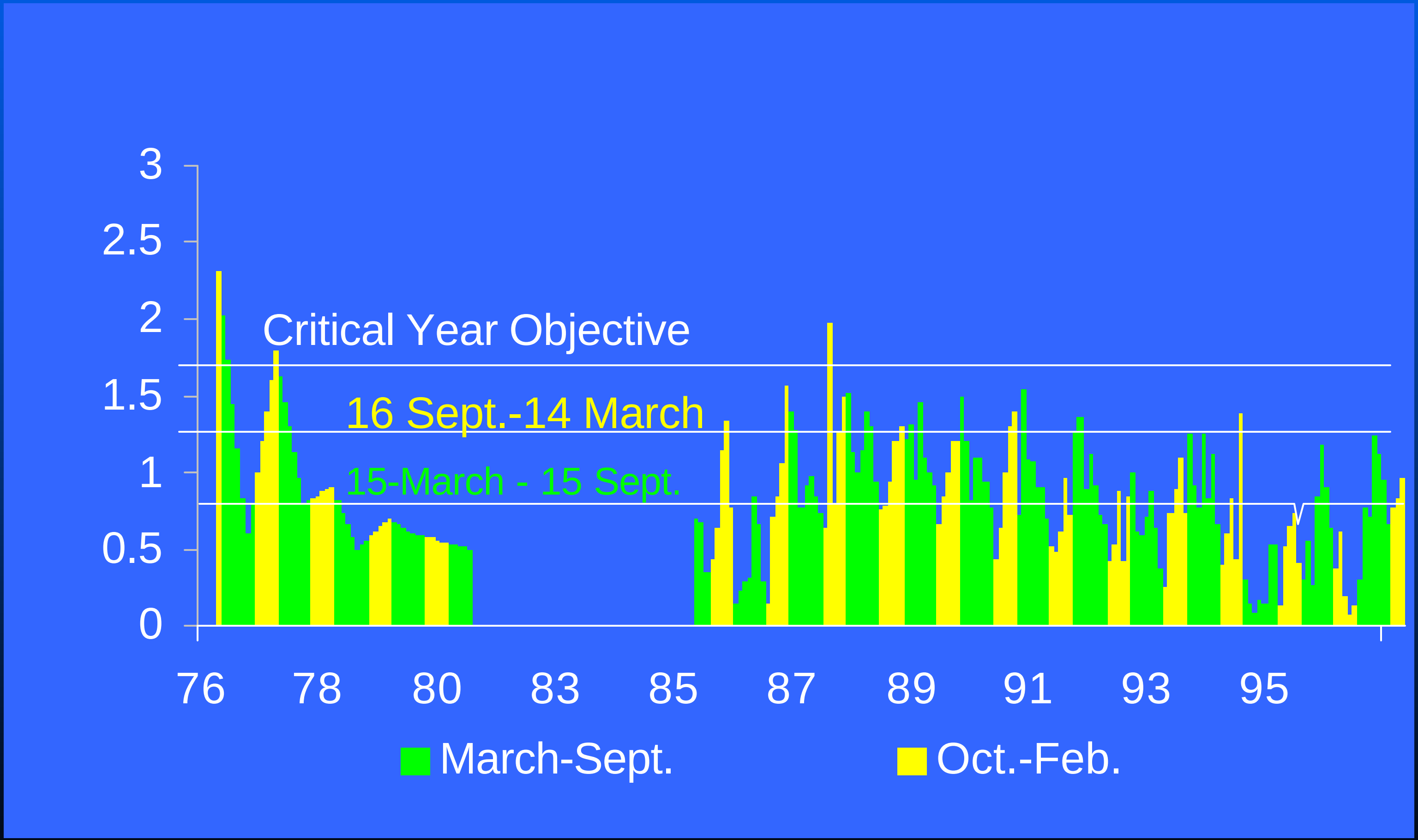
Year Around

0.6

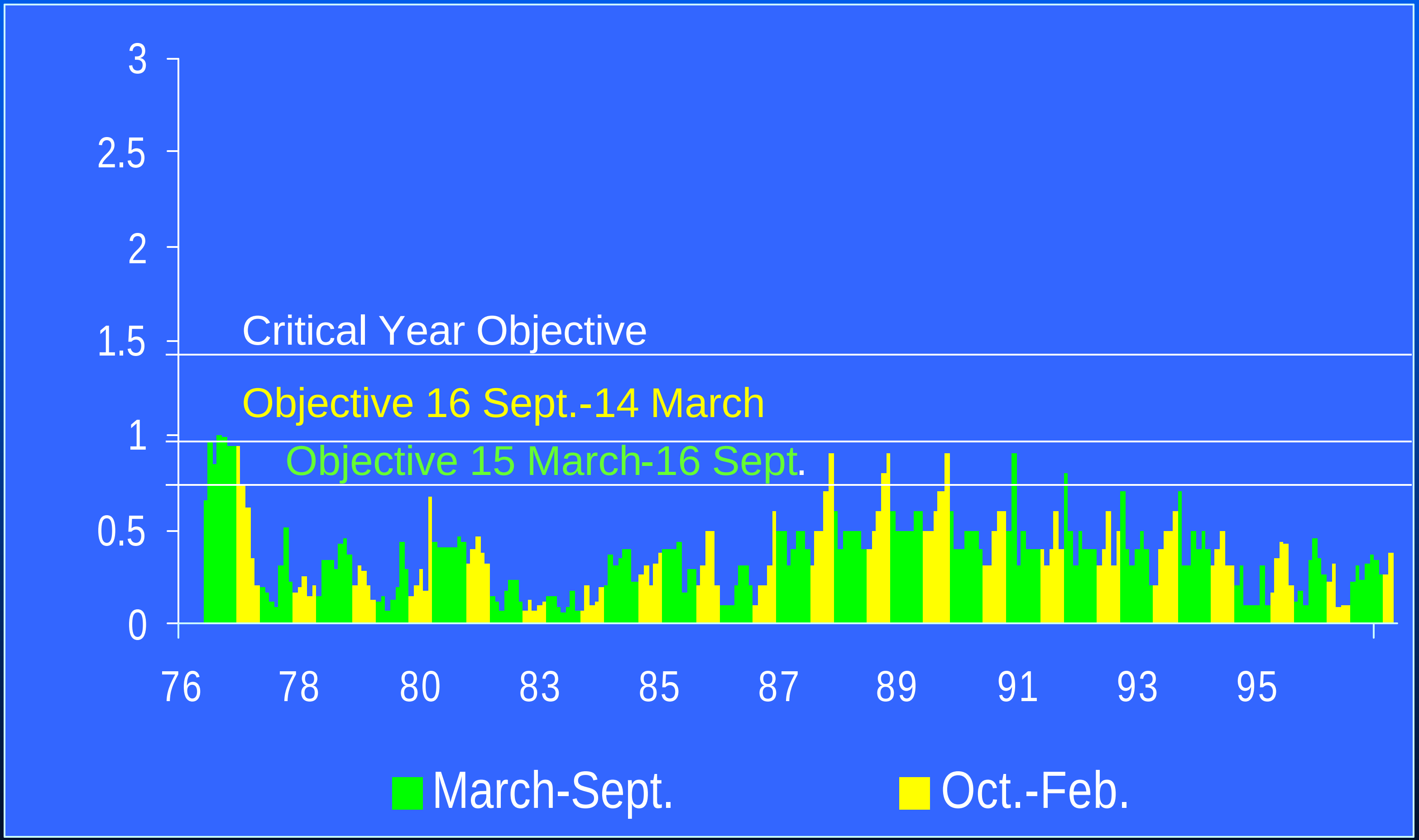
Boron No Action Alternative
Lander Avenue, 1976 - 1997



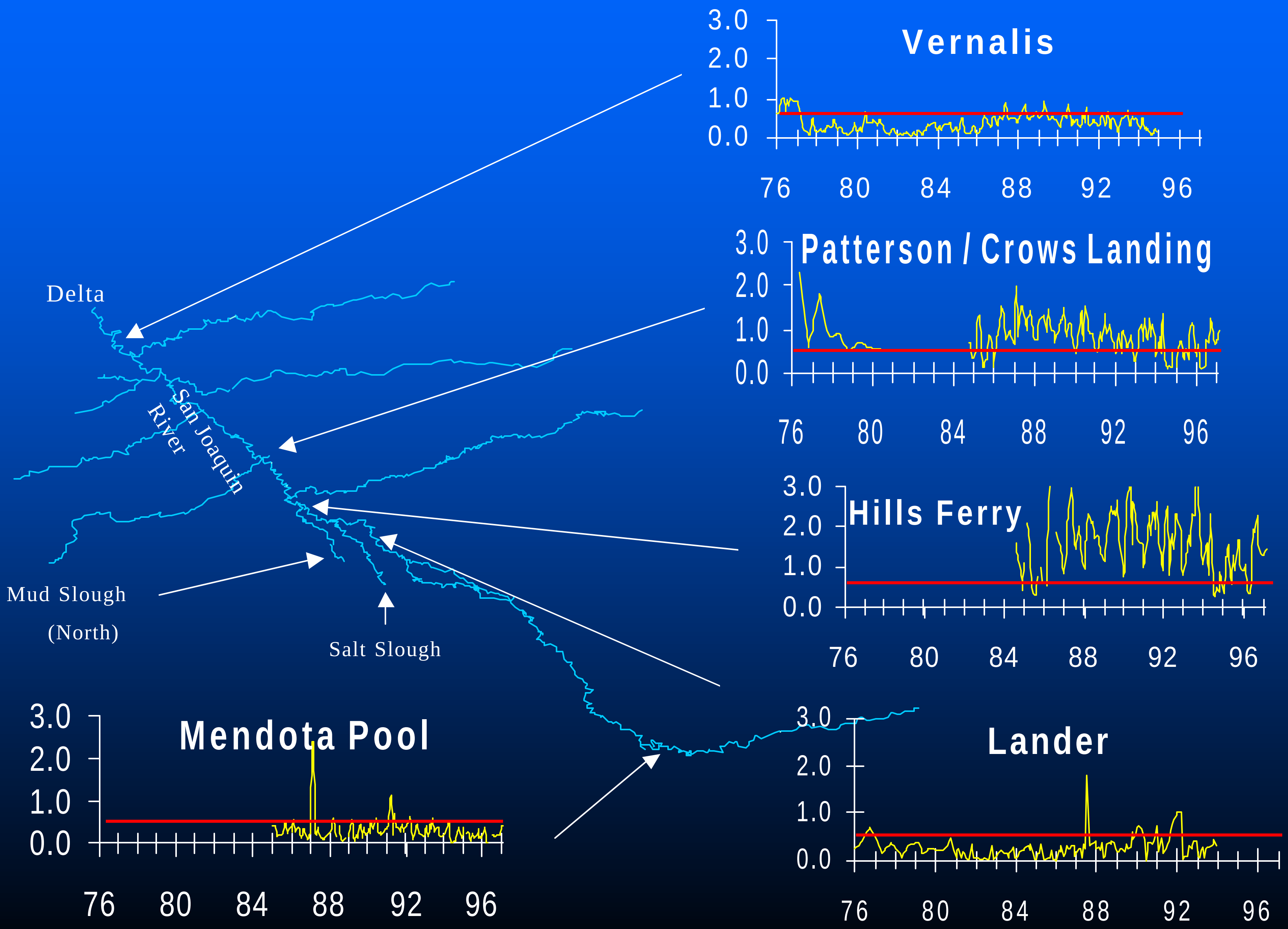
Boron No Action Alternative Patterson/Crows Landing, 1976 -1997



Boron No Action Alternative Vernalis, 1976 - 1997



Boron Full Protection Alternative



Summary of Alternatives

Salinity

- No Action
- Full Protection
- Delta Export

Boron

- No Action
- Full Protection

Flexibility of the Regional Board in Setting Objectives

- Seasonal Variations
- Vary by Sections of the River
- Water Year Considerations
- Meet State and Federal Laws and Policies

What Do We Need From You?

- Alternatives Under or Overly Protective ?
- Suggestions for Other Alternatives?
- Need Formal Comments

Questions and Comments Period

IMPLEMENTATION PROGRAM

Lower San Joaquin River
Salinity and Boron
Control Program

TOPICS

- Highlights of morning session
- Regional Board
- Methods for reducing salinity and boron
- Potential control program

Morning Session

- Background information
- Potential water quality objectives

REGIONAL BOARD

- Responsible for protecting beneficial uses of both surface waters and ground waters
- Authority over both point source and nonpoint source discharges

REGIONAL BOARD

- Basic regulatory tool: Waste Discharge Requirements
- Nonpoint sources: Management practices
- Prohibition of discharge
- Enforcement

Basin Plan
Implementation Chapter

- Explains how the Board will conduct a program to protect water quality
- Contains time schedules
- Describes surveillance and monitoring

Can Salinity and Boron Levels be Reduced?

Methods for Reducing Salt and Boron

- Less salt into the valley
- More water
- Less salt in drain water
- More salt out of valley
- Real time water management

Methods for Reducing Salt and Boron

- Less salt into the valley
- More water
- Less salt in drain water
- More salt out of valley
- Real time water management

Less Salt in Drain Water

- Water conservation
- Tailwater recovery
- Sequential reuse and volume reduction
- Evaporation ponds
- Water treatment
- Land retirement
- Active alternative land management

Less Salt in Drain Water

(Continued)

- Reduce municipal and industrial sources of salt
- Reduce other nonpoint sources
- Ground water management

Watershed Approach

- Control effort will address entire watershed
- Point and nonpoint source dischargers
- Water agencies
- Groups of water agencies and other regional entities

Approach

- Focus on waste management
- Does not address export of water from the watershed
- Does not address importation of salt

Nonpoint Source Dischargers

- State Water Resources Control Board's

Nonpoint Source Pollution Control Program

- Three-tier process
  - Voluntary
  - Regulatory-based encouragement
  - Full regulation

Waiver of WDRs for Irrigation Return Flows (tailwater)

- Current conditions:
  - “Operating to minimize sediment to meet Basin Plan turbidity objectives and to prevent concentrations of materials toxic to fish and wildlife.”
- Proposed:
  - For LSJR watershed, add conditions related to participation in (1) a local watershed effort and/or (2) an MOU to establish a real-time operation

Waiver of WDRs for Wetland Discharges

- Same as for irrigation return flows

Waiver of WDRs for Agricultural Subsurface Drainage

- WDRs already used to control selenium
- Use irrigation return flow waiver conditions for subsurface drainage in low selenium areas

Proposed Categories of Dischargers

- Dischargers operating under WDRs

- Dischargers meeting WDR waiver conditions
  - Discharge meets receiving water standards
  - Local Management Plans approved by Board
  - Participant in Basin-wide Real Time Management Program

Waste Discharge Requirements

- Sets limits
  - Volumes
  - Concentrations
  - Loads
  - Timing of discharge
- Time schedules
- Monitoring
- Enforceable

Proposed WDR Waiver Conditions

High Quality Discharges

- WDRs waived if no salt added and discharge meets receiving water standards

Proposed WDR Waiver Conditions

Local Management Plan

- Prepared by water agencies, groups of agencies, or others
- Requires:
  - Evaluation of control options
  - How/when changes will be made
  - Monitoring
- Board approval required
- Should qualify for Proposition 13 funds

Real Time Management Program

- Single agency
- Will be able to use assimilative capacity during high-flow conditions
- Responsible for:
  - Coordinating activities of participants
  - CEQA/WDRs
  - Identification/implementation of control measures

Total Maximum Daily Loads (TMDLs)

- Incorporated into WDRs
- Goal for management plans

Program Timeline

- First 18 Months
  - Conduct monitoring

Program Timeline

- Next 20 Months
  - Notify Board of intent
  - Cease discharge

  or

  - Prepare Management Plans

  or

  - Participate in development of Real-time Management Program

  or

  - Submit Report of Waste Discharge

Program Timeline

- Next 18 Months
  - – Board consideration of Management Plans and WDRs

Incentive

- Prohibition of discharge?
- Other approaches?

Point Sources

- Develop salinity/boron reduction plans
- Comply with TMDLs

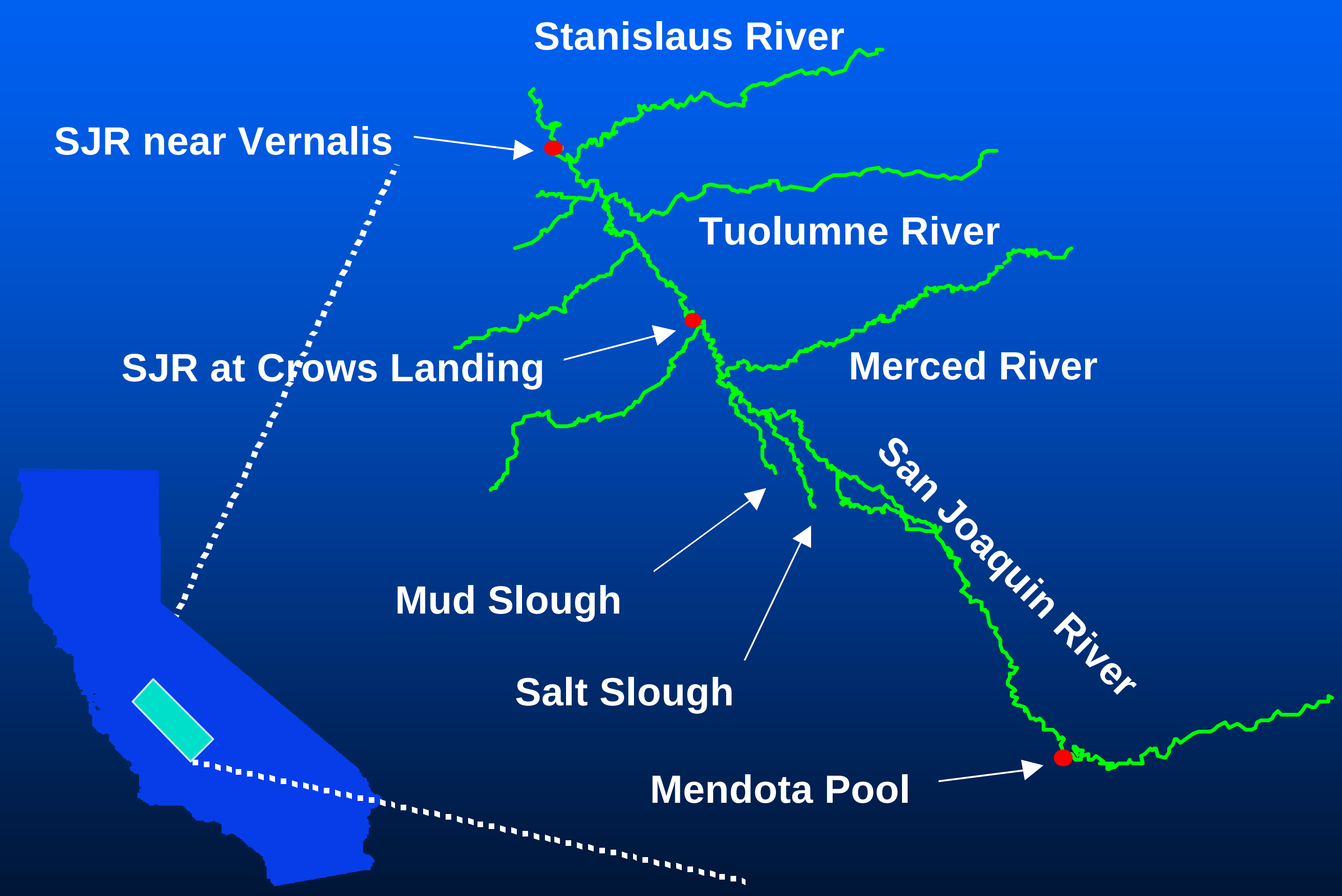
Groundwater Protection

- WDRs will be required for salt/boron storage and disposal sites

QUESTIONS

- Are there approaches to get involvement from:
  - Parties that divert water from the watershed
  - Parties that import salt into the watershed
- Are the timetables appropriate?
- For nonpoint source dischargers, are there incentives to participate other than a Prohibition of Discharge?

Lower San Joaquin River Basin



San Joaquin River Basin Plan Amendment Addressing Salinity and Boron

Real Time Water Quality Management

Introduction

- What
- Why
- History
- Current Status
- Future Application
- Questions, Discussion, and Comments

What Is Real Time Management?

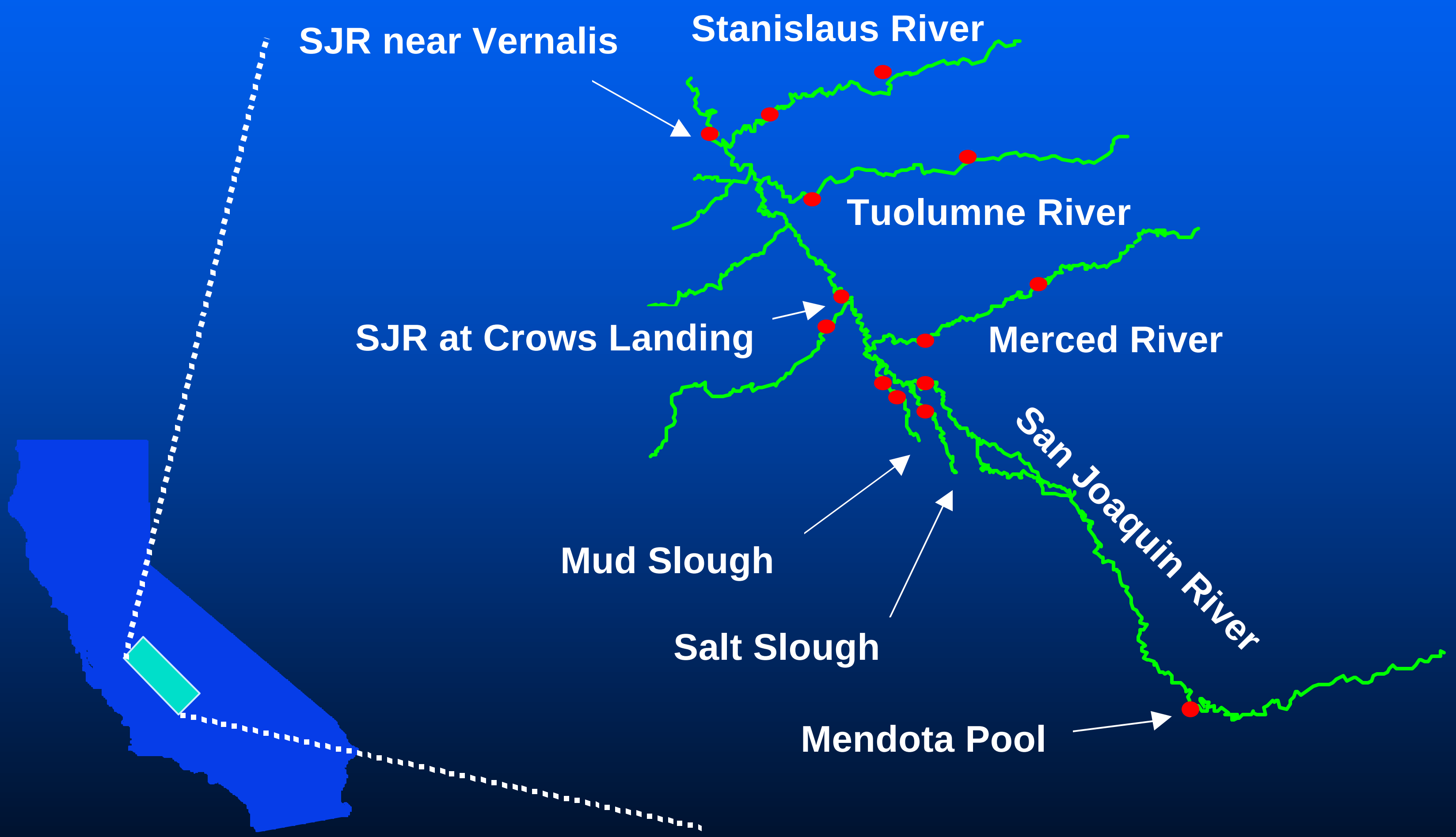
- Real time management is the real time coordination of discharges to meet water quality objectives
  - Real time: telemetry
  - Coordination: shift in the timing of both freshwater and saline water discharges
- What is needed for real time management?
  - Monitoring data and telemetry
  - Processing and modeling of this data
  - Management using the processed data

Why Real Time Management?

- Opportunity
- Necessity
- Utility

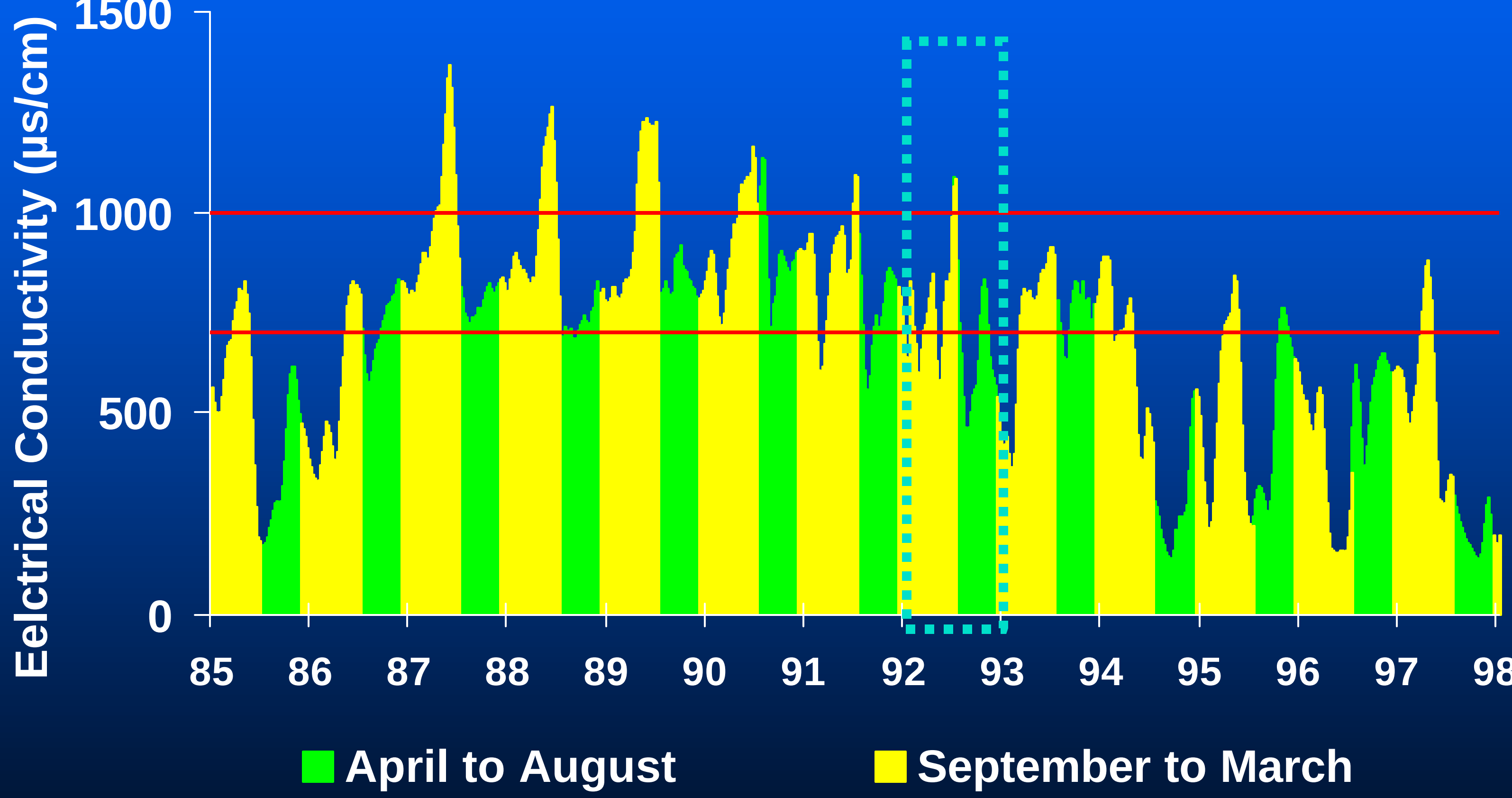
Lower San Joaquin River Basin

Real Time Monitoring Stations



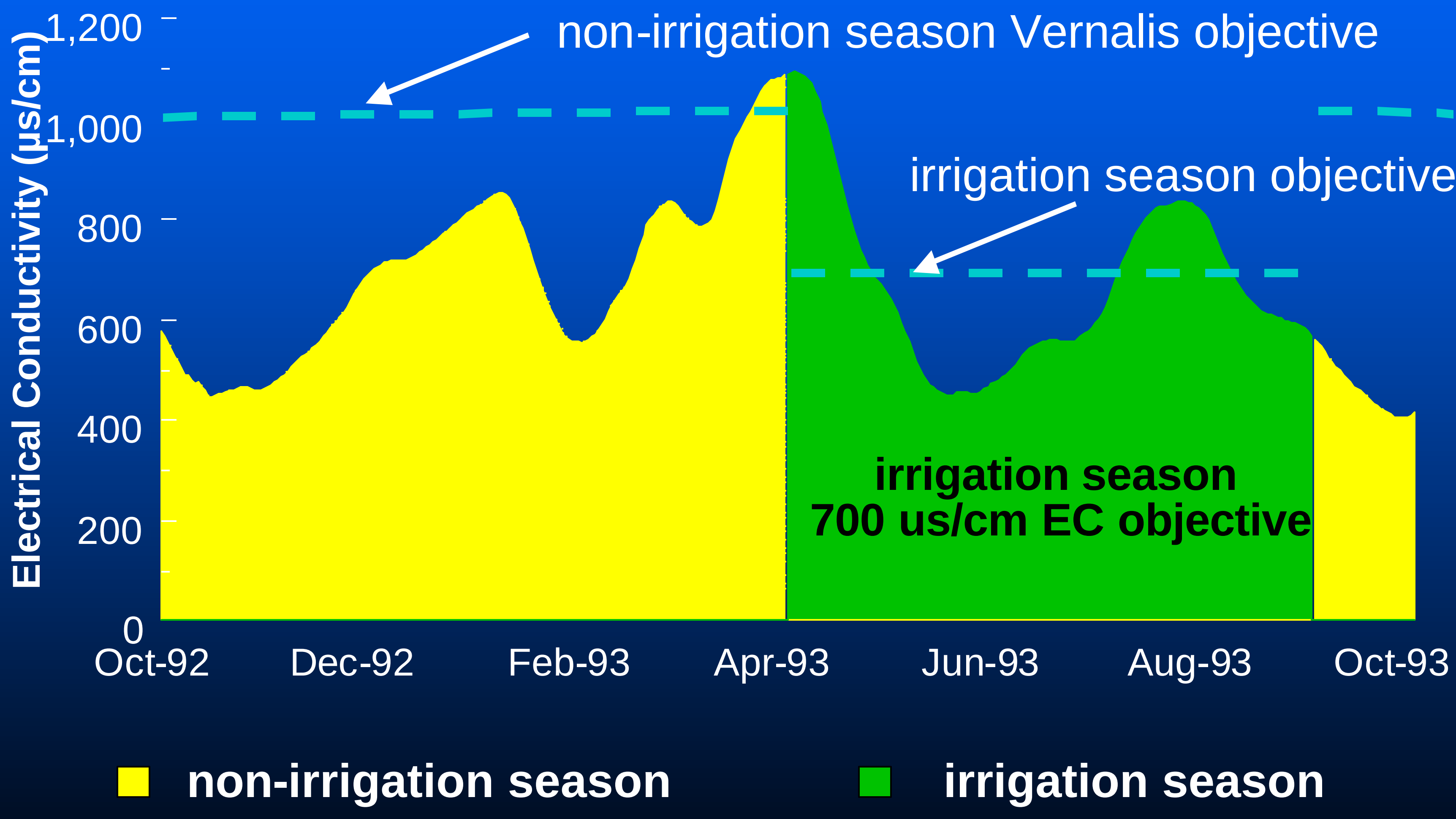
San Joaquin River near Vernalis

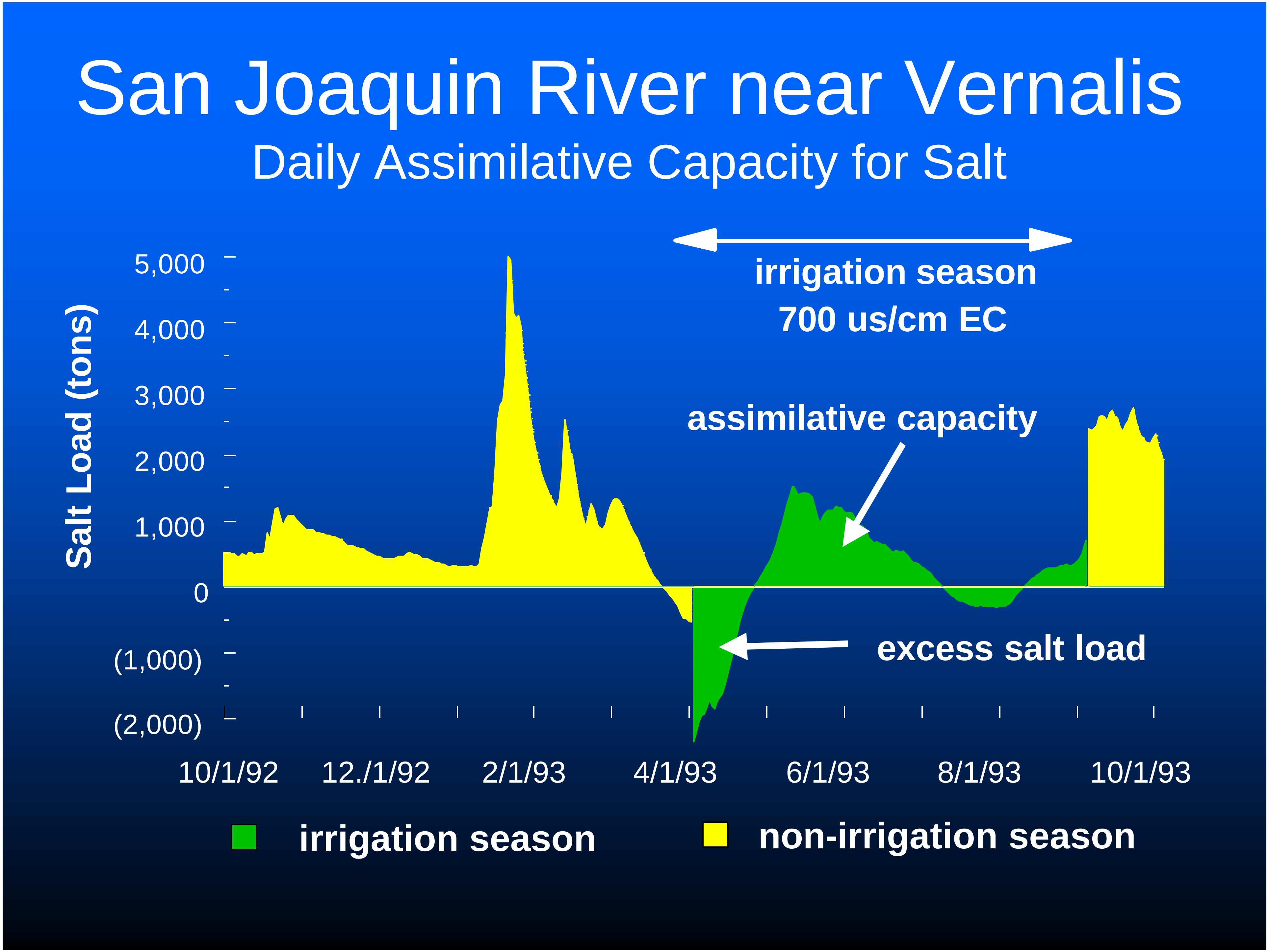
30 Day Running Average Electrical Conductivity



San Joaquin River near Vernalis

30 Day Running Average Electrical Conductivity




San Joaquin River near Vernalis
Daily Assimilative Capacity for Salt
Salt Load (tons)
5,000
4,000
3,000
2,000
1,000
0
(1,000)
(2,000)
10/1/92
12./1/92
2/1/93
4/1/93
6/1/93
8/1/93
10/1/93
irrigation season
700 us/cm EC
assimilative capacity
excess salt load
irrigation season
non-irrigation season

Necessity

- No other project can both:
  - increase frequency of meeting water quality objectives
  - allow for discharge of salts from basin
- SWRCB direction:
  - 1995 WQCP
  - 1999 bay delta decision
- Big part of regional board salt and boron basin plan amendment implementation plan

Utility

- Past efforts of Grassland Water District:
  - reoperation and wetland flushing
- SWRCB WQCP EIR modeling studies:
  - tile drainage reoperation
  - wetland reoperation
- VAMP flow estimates:
  - Spring 1999

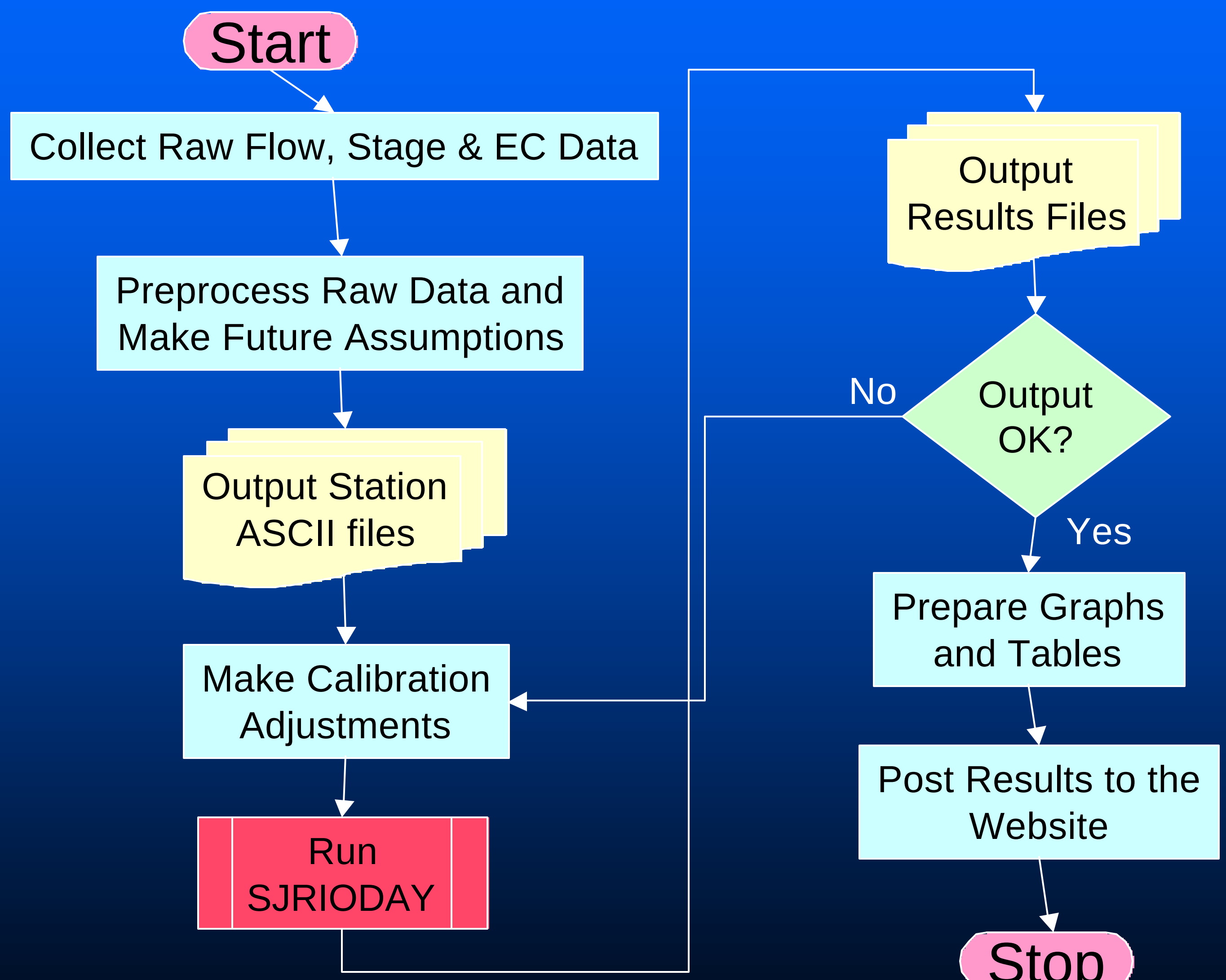
Chronology of Real-Time Management

- Alex Hildebrand (SDWA) and Charlie Kratzer (SWRCB)
- SJRMP Water Quality Subcommittee
- USBR Challenge Grant demonstration project
- MOU
- CALFED Grant (San Joaquin River Management Program Water Quality Subcommittee)

Current Status

- Operating under a two-year CALFED Grant
  - Adding and upgrading stations
  - Processing data
  - Making forecasts
  - Soliciting feedback / participation

Water Quality Forecast - Process

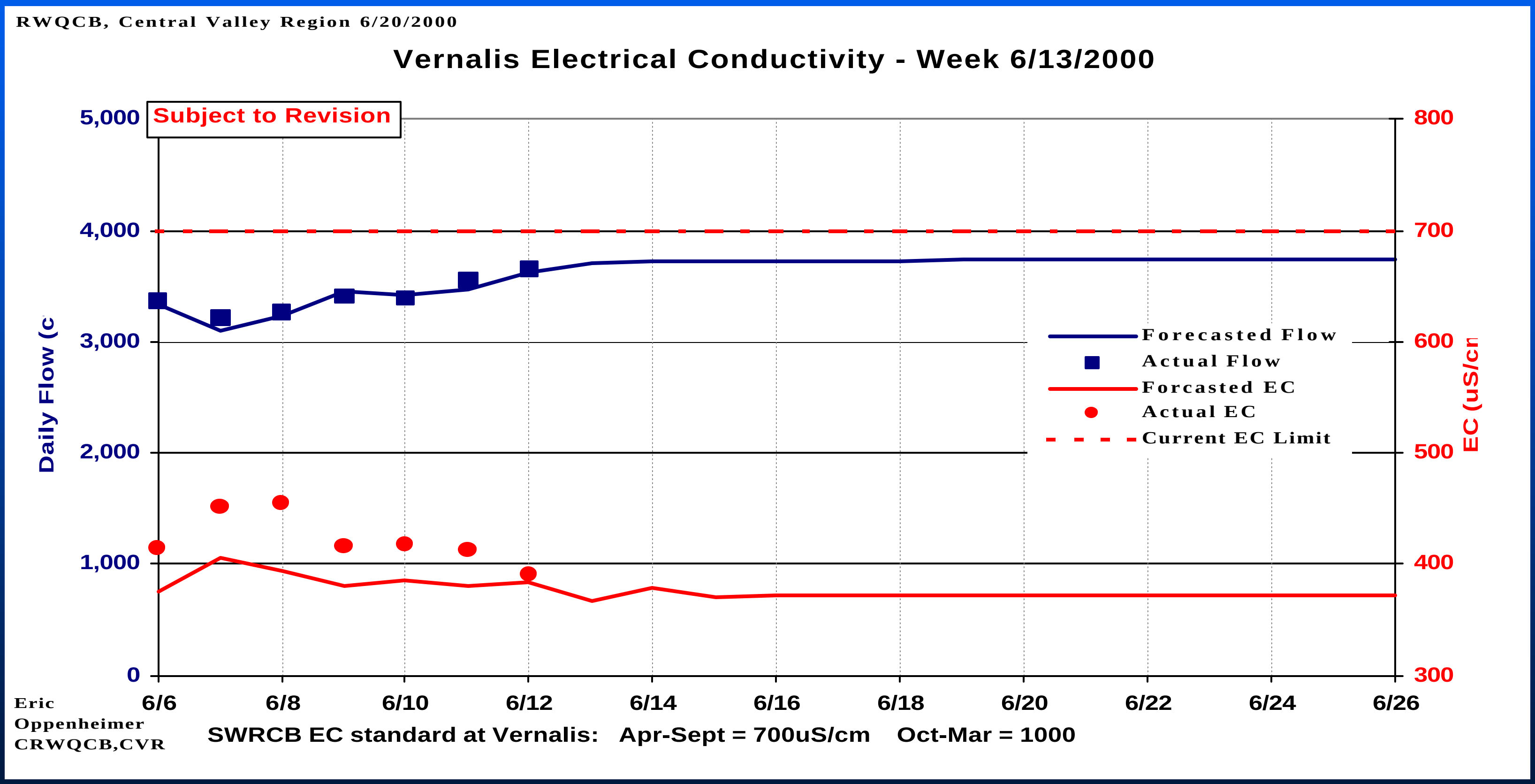


Data Sources

San Joaquin River	4
Merced River	3
Tuolumne River	2
Stanislaus River	3
Orestimba Creek	1
Wetlands Area	2
Precipitation	4
Auxiliary	4
Total =	**23**

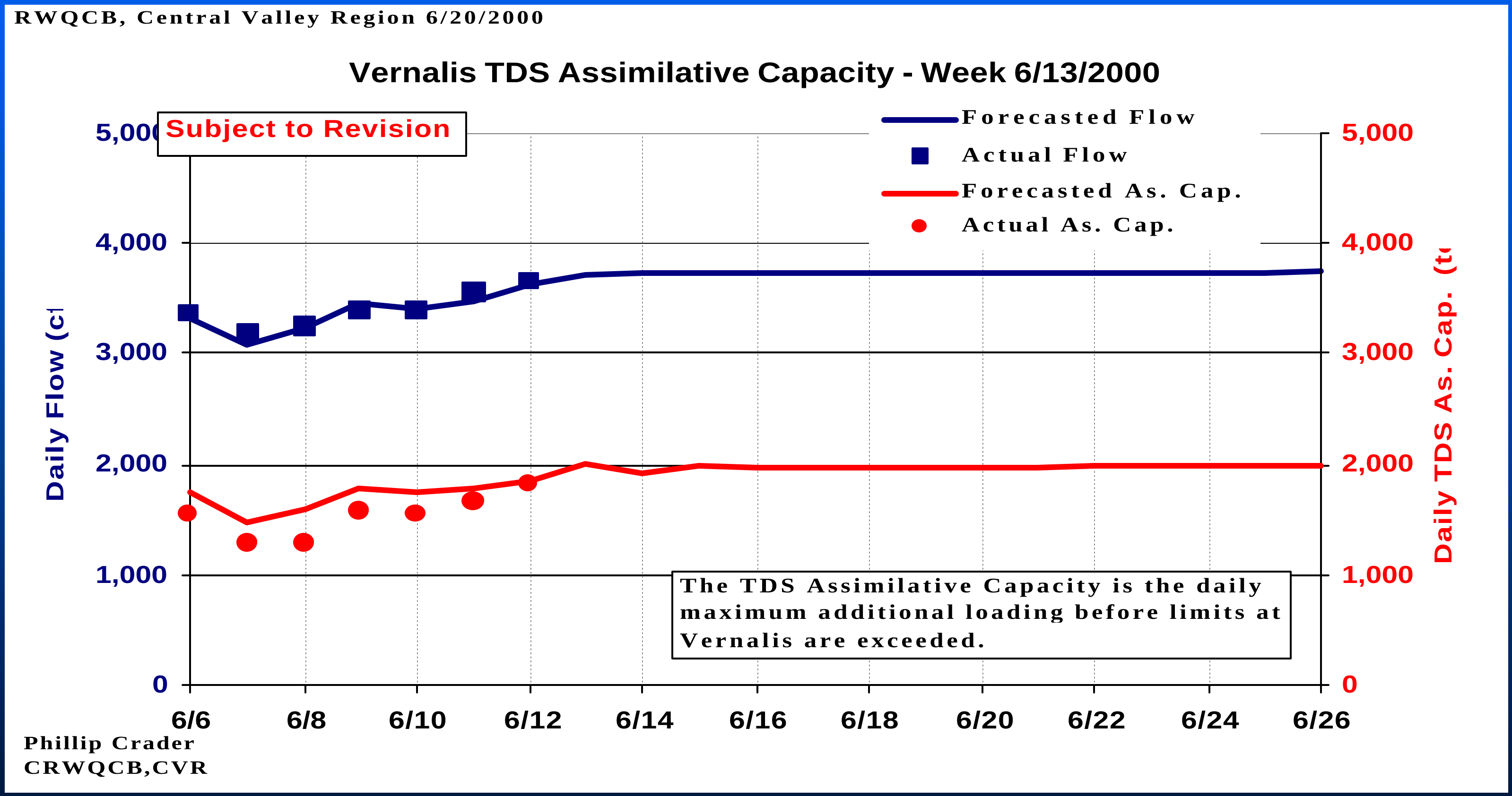
Sample Forecast

Vernalis Flow and EC



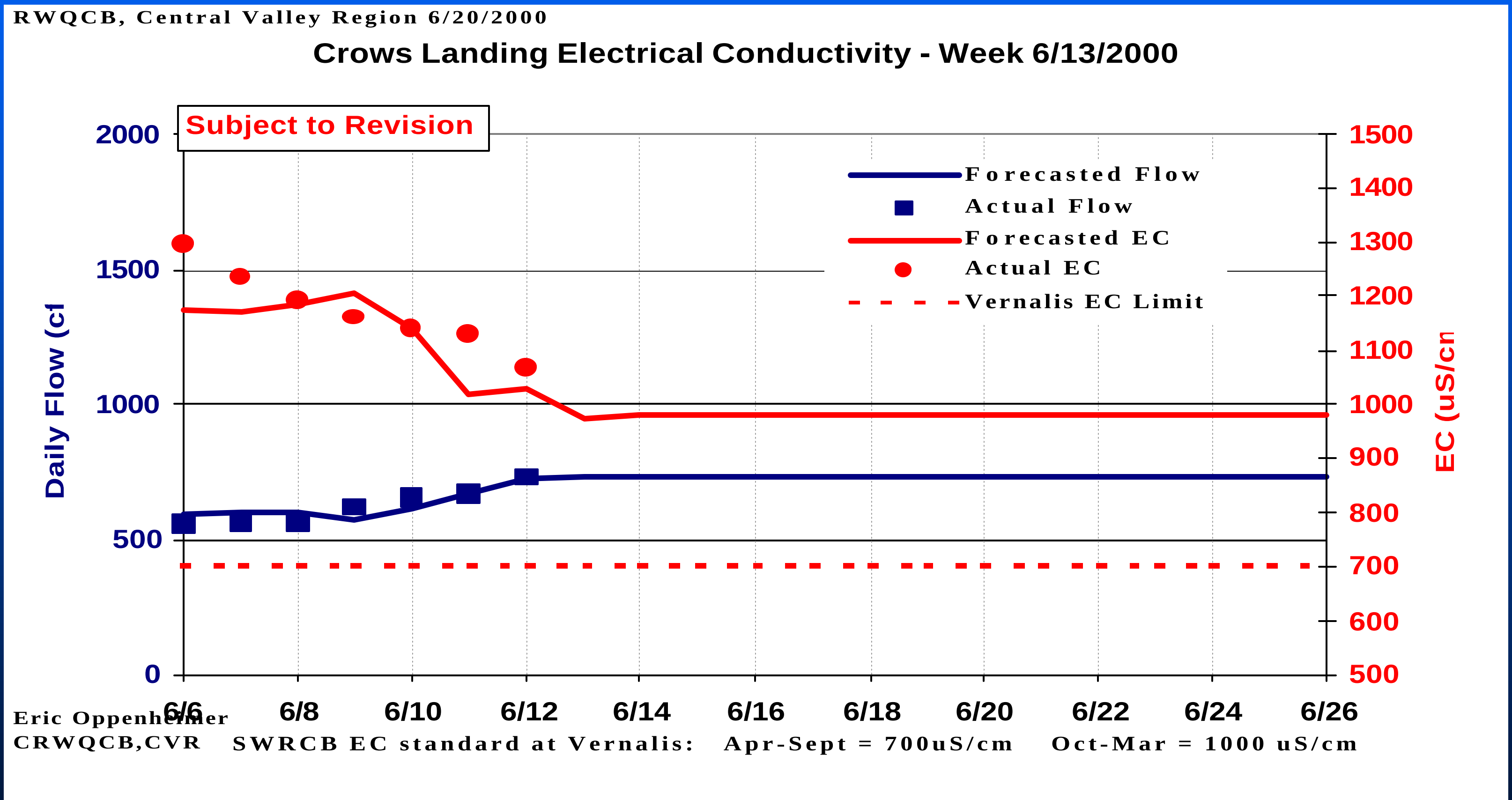
Sample Forecast

Vernalis Flow and TDS Assimilative Capacity



Sample Forecast

Crows Landing Flow and EC

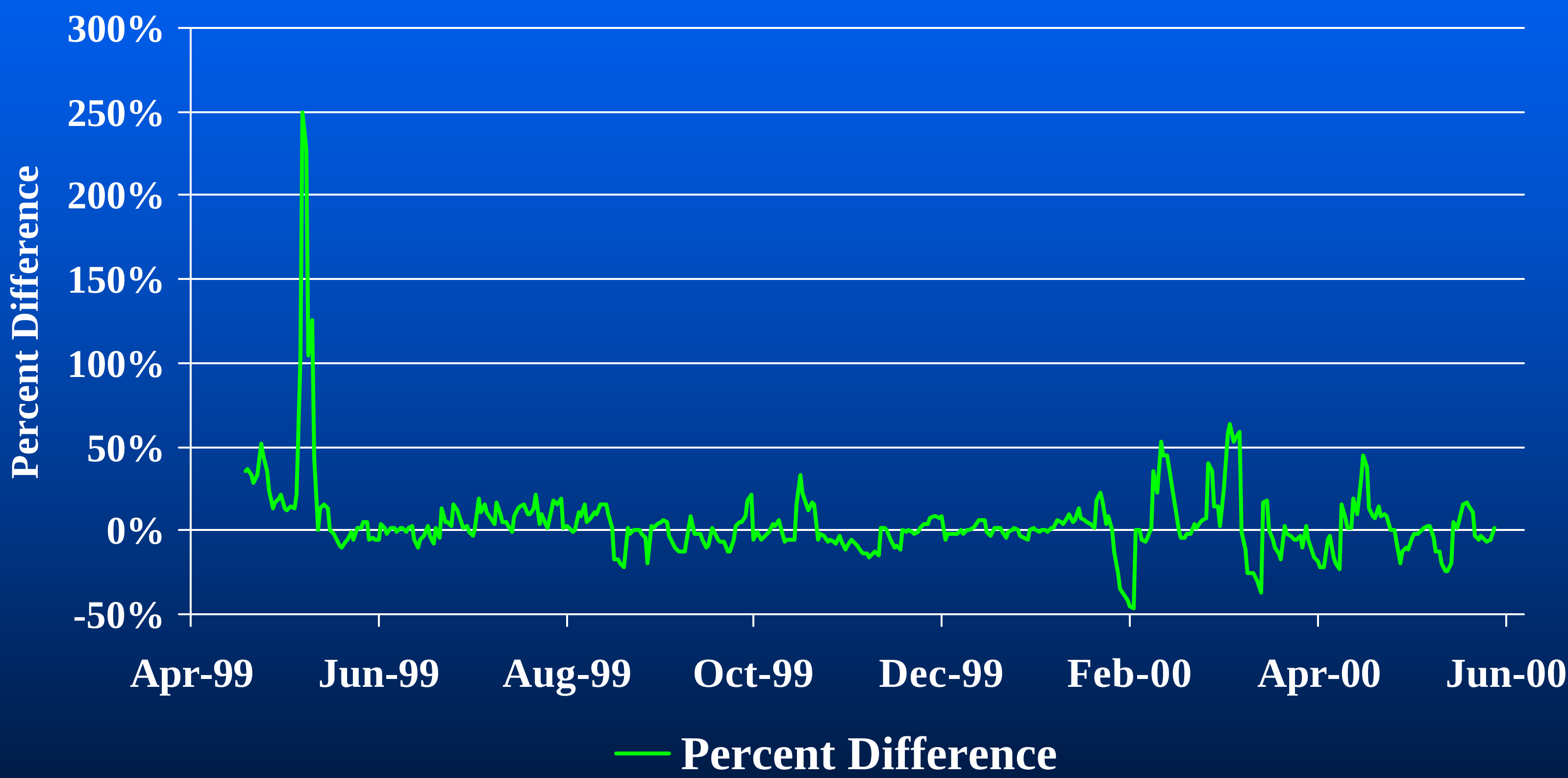


SJR near Vernalis EC

Real Time Model versus Actual

SJR near Vernalis EC

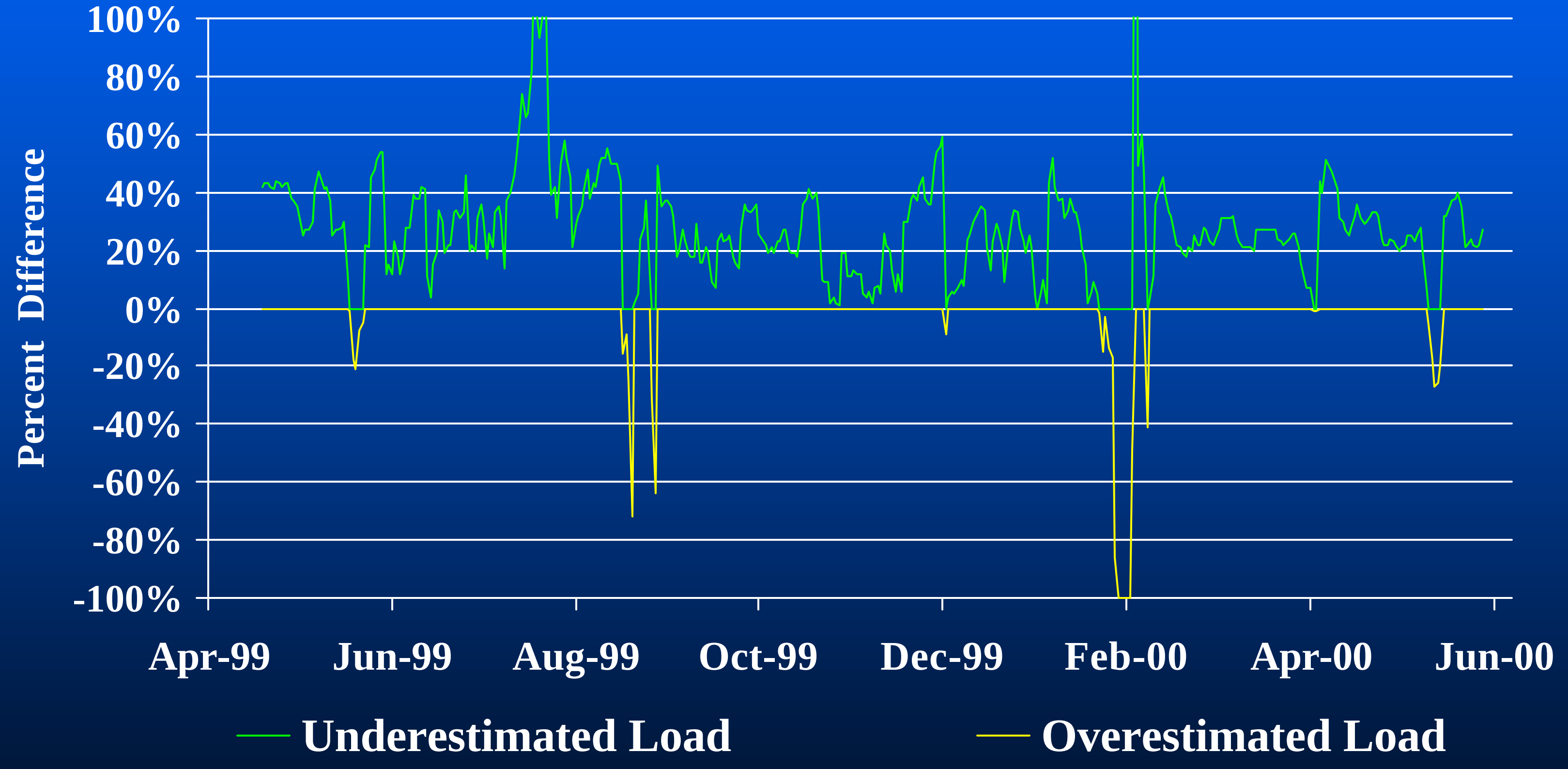
Real Time Model versus Actual
Percent Difference



SJR near Vernalis
Salt Load Assimilative Capacity
Real Time Model versus Actual

Salt Load Assimilative Capacity in the SJR near Vernalis

(Percent difference with 25 % margin of safety)



Future Application

- Basin-wide application of real-time management will require coordination of:
  - Water districts
  - Drainage districts
  - Joint powers authorities
- Lack of coordination will reduce the ability to discharge salts to the SJR

More Information

- For more information on the CALFED funded San Joaquin River Real-time Program, log on to the Department of Water Resources, San Joaquin District Real-time web page:

  http://wwwdpla.water.ca.gov/sjd/waterquality/realtime/index.html

Questions

- Is the concept of real-time management clear?
- Should real-time management be part of the implementation plan for the control of salts?
- Can management efforts in the basin be coordinated? And if so, how?